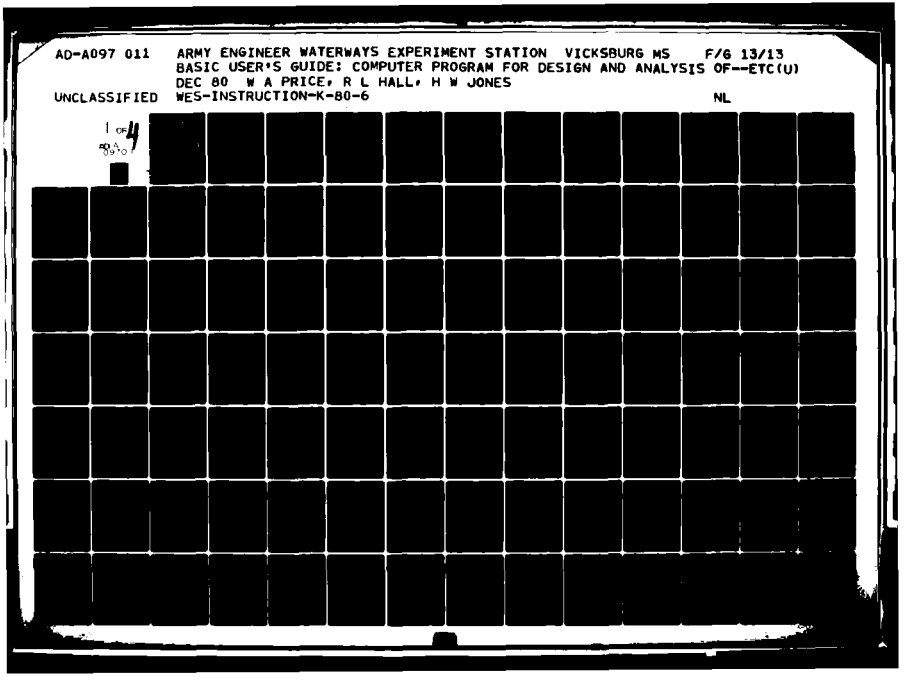

AD-A097 011
ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS F/G 13/13
BASIC USER'S GUIDE: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF--ETC(U)
DEC 80 W A PRICE, R L HALL, H W JONES
UNCLASSIFIED
WES-INSTRUCTION-K-80-6
NL
1 OF 4
AD A097011

INSTRUCTION REPORT K-80-6

BASIC USER'S GUIDE: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (TWDA)

by

William A. Price, Robert L. Hall
H. Wayne Jones, Reed L. Mosher, Michael E. George

Automatic Data Processing Center
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

December 1980

Final Report

A report under the Computer-Aided Structural Engineering (CASE) Project

Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

and

U. S. Army Engineer Division, Lower Mississippi Valley
P. O. Box 80, Vicksburg, Miss. 31980

Destroy this report when no longer needed. Do not return it to the originator.

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:

DAEN-CWE-DS

23 February 1981

SUBJECT: Instruction Reports K-80-6, K-80-7, and K-81-3: The Basic User's Guide, User's Reference Manual, and Validation Report for a Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)

All Corps Elements with Civil Works Responsibilities

1. The subject reports document a computer program for analyzing and designing reinforced concrete retaining walls and floodwalls. This computer program was developed according to specifications provided by the members of the Computer-Aided Structural Engineering (CASE) Task Group for T-Walls. As is the goal with all CASE tasks, the intent is to make an organized, cost-effective computer solution available to the Corps' designers for use when the need arises.

2. Engineers will be readily able to tell by the description of the program and by the examples given in the reports of the applicability toward their needs. Detailed documentation of the program may be obtained from the Engineering Computer Programs Library (ECPL) of the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss.

3. We strongly encourage the use of this program where applicable throughout the Corps.

FOR THE CHIEF OF ENGINEERS

Lloyd A. Dusch

LLOYD A. DUSCHA
Chief, Engineering Division
Directorate of Civil Works

(14) WES-INSTRUCTION-K-80-6

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Instruction Report K-80-6	2. GOVT ACCESSION NO. AD-A097011
3. RECIPIENT'S CATALOG NUMBER	(9)
4. TITLE (and Subtitle) BASIC USER'S GUIDE: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (TWDA)	5. TYPE OF REPORT & PERIOD COVERED Final report
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) William A. Price, Reed L. Mosher, Robert L. Hall, Michael E. George, H. Wayne Jones	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Automatic Data Processing Center P. O. Box 631, Vicksburg, Miss. 39180	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Office, Chief of Engineers, Washington, D. C. 20314 and U. S. Army Engineer Division, Lower Mississippi Valley, P. O. Box 80, Vicksburg, Miss. 39180	12. REPORT DATE December 1980 13. NUMBER OF PAGES 150
14. MONITORING AGENCY NAME & ADDRESS (If different from Controlling Office) (12) 157	15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

This report was prepared under the Computer-Aided Structural Engineering (CASE) Project. A list of published CASE reports is printed on the inside of the back cover.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Computer programs
Computerized simulation
Design criteria
Flood walls
Retaining walls

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Computer program TWDA (T-wall design/analysis) is a user-oriented conversationally interactive, modular time-sharing program system for computer-aided structural design of inverted-T retaining walls and floodwalls founded on earth or rock. Its essential characteristics include:

a. List-directed input with prompting available on request or as shown to be needed. Data lists may be entered interactively or in a data file.

(Continued)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

251

20. ABSTRACT (Continued)

b. Design for minimum cost including excavation, backfill, slab concrete, and stem concrete, with inputted unit costs. Default is to design for minimum concrete volume.

c. Multiple soils strata may be used as existing and/or backfill earth. Either Coulomb's equation or trial wedges may be used to get active earth pressures.

d. Multiple slopes may be used to model existing and/or finished grade surfaces.

e. Time-sharing printout is limited to the minimum needed by the user to make his design decisions. A full analysis report is available in an optional output file that may be listed on any terminal.

f. The program is structured to permit easy updating as criteria change.

g. Up to 10 load cases may be used. The user does not need to reeenter any data by hand into subsequent runs.

h. The 1977 edition of ACI code 318 is used. Default procedures conform to the Corps of Engineers' Engineer Manuals in effect in 1980. The user may, however, direct the program to change many of the standard procedures as needed.

i. Earthquakes may be considered using an acceleration factor that is applied to the static load.

j. Input data and output results may be displayed on a Tektronix 4014 terminal.

k. Multiple surcharges may be included in the data.

The program is divided into three major sections: the executive command phase, the stability group of modules, and the structural group of modules:

a. The executive command phase is where the program starts executing and where is returns to after running the computational modules. Commands and data are entered in this phase of the program.

b. The stability group of computational modules computes active earth pressures and determines overturning and sliding stability.

c. The structural group of computational modules performs a stress analysis of the wall or designs for minimum slab thicknesses.

The philosophy of TWDA is to (a) ensure minimum-cost adequate design based on current codes and criteria, independent of the user's experience, and to (b) promote the use of personal judgment and imagination through man-machine interaction.

PREFACE

This user's guide describes the basic use of TWDA, a computer program for design and analysis of inverted-T retaining walls and floodwalls. The program is a product of the Computer-Aided Structural Engineering (CASE) Project of the Office, Chief of Engineers, U. S. Army (OCE), and of the Computer-Aided Structural Design (CASD) Project of the U. S. Army Engineer Division, Lower Mississippi Valley (LMVD).

Mr. William A. Price, Chief, Computer-Aided Design Group (CADG), Automatic Data Processing (ADP) Center, U. S. Army Engineer Waterways Experiment Station (WES), provided the overall design of the program and led the program development team. The program and this user's guide were written by Mr. Price and Messrs. Robert L. Hall, H. Wayne Jones, Reed L. Mosher, and Michael E. George, all of the CADG. The work was managed and coordinated by Dr. N. Radhakrishnan, Special Technical Assistant, ADP Center, assisted by Mr. Paul K. Senter, CADG. Mr. Donald L. Neumann was Chief of the ADP Center. Mr. Donald R. Dressler was the point of contact in OCE.

The program was written according to specifications provided by the members of the CASE Task Group on T-Walls and of LMVD's CASD Committee and by other Corps personnel:

CASE Task Group on T-Walls

Victor M. Agostinelli, LMVD (Chairman)
Terry C. Cox, LMVD
Alvis Eikstrems, North Atlantic Division
Stacey Anastos, North Atlantic Division
Joseph V. Milliorn, formerly with New Orleans District
Raymond Veselka, Galveston District

LMVD's CASD Committee

Victor M. Agostinelli, LMVD (Chairman)
Arvis R. Dennis, Vicksburg District
Clifton C. Hamby, Vicksburg District
Sefton B. Lucas, Memphis District
Joseph Barber, Memphis District
James G. Bigham, New Orleans District
Joseph V. Milliorn, formerly with New Orleans District
James J. Smith, St. Louis District
Thomas J. Mudd, St. Louis District
James Cronin, St. Louis District
Carlton Smith, St. Louis District

OCE (DAEN-CWE-DS) Personnel

Keith O. O'Donnell, former Chief, Structural Engineering Section (retired)
Donald R. Dressler
Lucian G. Guthrie

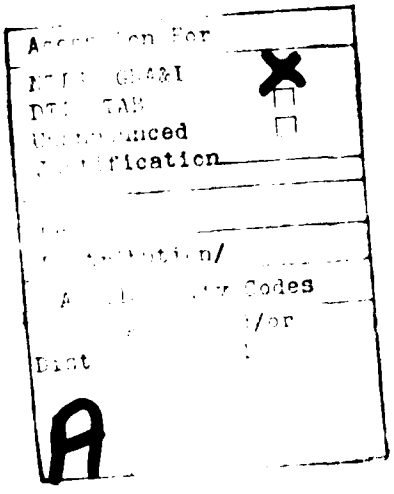
Other Corps Personnel

Carl E. Pace, Structures Laboratory, WES
William A. Price, ADP Center, WES
James D. Wall, South Atlantic Division

The following WES personnel contributed to the coding of the program: Messrs. Price, Hall, Jones, Mosher, and George of the CADG and Messrs. Edward F. O'Neil III and Roy E. Campbell of the Structures Laboratory. Dr. William P. Dawkins, Oklahoma State University, and Dr. Michael W. O'Neill, University of Houston, contributed routines under contract to WES.

A user's reference manual and a program verification report will also be published on TWDA. Documentation of the program specifications is available from LMVD.

Directors of WES during the development of this program and the publication of this user's guide were COL J. L. Cannon, CE, and COL N. P. Conover, CE. Technical Director was Mr. F. R. Brown.



CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONVERSION FACTORS, INCH-POUND TO METRIC (SI)
UNITS OF MEASUREMENT

Inch-pound units of measurement used in this manual can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
cubic yards	0.7645549	cubic metres
feet	0.3048	metres
inches	2.54	centimetres
pounds (force)	4.448222	newtons
pound (force)-feet	1.355818	newton-metres
pounds (force) per foot	14.5939	newtons per metre
pounds (force) per square foot	47.88026	pascals
pounds (force) per square inch	6.894757	kilopascals
pounds (mass) per cubic foot	16.01846	kilograms per cubic metre
square inches	6.4516	square centimetres

ELECTRONIC COMPUTER PROGRAM ABSTRACT

TITLE OF PROGRAM	PROGRAM NO
TWDA - T-Wall Design Analysis (CORPS No. X0055)	713-F3-R0-027

PREPARING AGENCY

U. S. Army Engineer Waterways Experiment Station, ADP Center, CADG

AUTHOR(S)	DATE PROGRAM COMPLETED	STATUS OF PROGRAM	
		PHASE	STAGE
William A. Price, Robert L. Hall, H. Wayne Jones, Reed L. Mosher, Michael E. George	June 1980	Operational	

A PURPOSE OF PROGRAM

Analysis or design of an inverted-T wall subjected to retaining wall and/or floodwall loadings. Design comparisons for finding the most economical combination of base embedment, key length, base width, and base slope are based on construction cost of excavation, concrete, and backfill. Performs stability analysis or design and structural analysis or design. Conforms to Engineer Manual 1110-2-2501, EM 1110-2-2505, and other Corps of Engineers standards.

B PROGRAM SPECIFICATIONS

The program is written in FORTRAN IV. The graphics display option uses the Graphics Compatibility System (GCS).

C METHODS

Active earth pressures may be calculated by Coulomb's equations or by the incremental wedge method. The program is highly interactive, following a computer-aided design methodology. The analysis procedure considers overturning, sliding, and bearing pressure, relative to the soil immediately adjacent to the wall. Earthquake effects are included. Stress design includes determination of reinforcement.

D EQUIPMENT DETAILS

Time-sharing mainframe computer (overlaid for 49k words of main memory.

Time-sharing terminal--Tektronix 4014 needed for graphic display option. Rest of program may be run on any interactive terminal.

Remote high-speed job entry terminal (COPE, etc.).

E INPUT-OUTPUT

Input is by time-sharing keyboard, either directly or via data files. Intermediate data are stored in disc files. Output is to the time-sharing terminal and/or to a high-speed computer terminal.

F ADDITIONAL REMARKS This program was written under the auspices of the OCE Computer-Aided Structural Engineering (CASE) Project Task Group on T-Walls and the LMVD Computer-Aided Structural Design (CASD) Committee. Call W. A. Price, FTS: 542-3645, for more information. Available publications include the Basic User's Guide, the User's Reference Manual, and the Program Validation Manual. They are available from the ECPL of the WES Technical Information Center. Documentation of the program specifications is available from LMVD.

BASIC USER'S GUIDE: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (TWDA)

CHAPTER 1: INTRODUCTION

1-1 PURPOSE OF PROGRAM TWDA AND THIS BASIC USER'S GUIDE

1-1-1 TWDA is a computer-aided structural design system for analysis and/or design of inverted-T cantilever walls founded on earth or rock. Multiple load cases allow the wall to act as a floodwall or a retaining wall.

1-1-2 This user's guide describes basic capabilities of TWDA. Users are referred to the User's Reference Manual* for a complete description of capabilities and interpretation of the output.

1-2 SCOPE. Chapters 2 through 6, 10, and 11 constitute the basic instructions. Once the user has become familiar with these chapters, Chapters 7 through 9 serve as a step-by-step data preparation checklist. Chapter 12 is furnished as a data reminder list that can be used as a quick reference for coding. Chapter 13 describes the use of the graphics display capabilities. Chapter 14 presents examples of how the program can be used.

---

* Price, W. A. et al. 1980. "User's Reference Manual: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)," Instruction Report K-80-7, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

CHAPTER 2: DESCRIPTION OF BASIC PROGRAM CAPABILITIES

2-1 GENERAL. TWDA uses a problem-oriented command language with data grouped into named lists that may be entered in any order convenient to the user. Data and most commands may be entered interactively or via data file. Program output includes graphic display of data and results. See the documentation of the program criteria specifications* for details on structural criteria used in TWDA.

2-1-1 Unit Slice. Stability and stress analysis and design are for a unit slice of straight wall 1 ft long.**

2-1-2 Basic Command Language. The basic command language enables the user to control:

a. Type of program start: INIT or RESTore. INIT = fresh start with all new data. REST = restart from old update file.

b. Starting a computation procedure ("module") after the required data have been entered.

c. Review and editing of data already entered using the LOOK command.

d. Resetting (updating) the update file for future use of the REST command.

e. End of a program run.

f. Requests for information about a data item or what data items are required for a given computation module.

2-1-3 Load Cases. Up to 10 load cases may be entered in each program run. Data may be designated to be for all load cases or for any 1 load case.

2-2 ACTIVE EARTH PRESSURES. The active earth pressures for basic use of the program are calculated according to Coulomb's equation for active earth pressure, as described in Engineer Manual 1110-2-2502.*

2-2-1 Basic use of TWDA to determine floodwall stability assumes a vertical crack in the earth cover at the end of the heel, precluding use of active pressures but allowing the consideration of additional,

---

* Copies of the documentation are available from the U. S. Army Engineer Division, Lower Mississippi Valley, Vicksburg, Miss.

** A table of factors for converting inch-pound units of measurement to metric (SI) units is presented on page vii.

* Headquarters, Department of the Army. 1961. "Retaining Walls," with Change 3, 25 Jan 1965, Washington, D. C.

optional external applied water pressure in the vertical crack due to wave force base pressures.

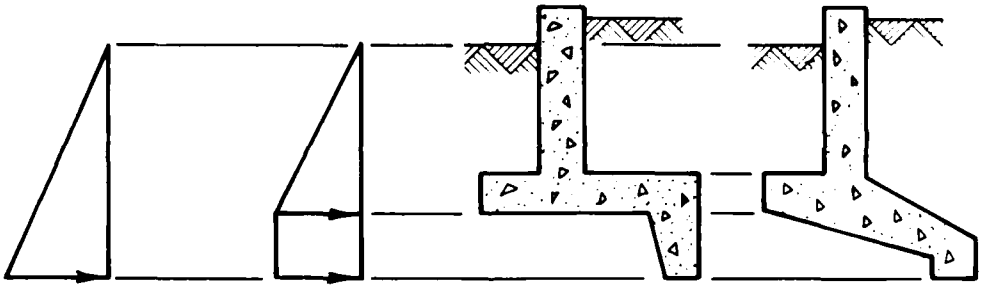
2-2-2 Basic use of TWDA to determine retaining wall stability assumes active earth pressures at the end of the heel with no crack in the earth cover.

2-2-3 TWDA calculates active earth pressures on the stem for use in stress analysis/design.

2-3 PASSIVE EARTH PRESSURES FOR SLIDING. Passive earth pressures for sliding calculations are from Coulomb's equation, as described in EM 1110-2-2502.

2-4 HORIZONTAL EARTH RESISTANCE FOR OVERTURNING. Horizontal earth resistance for overturning calculations depends on several factors:

2-4-1 With a key, the net horizontal unbalanced force is resisted by passive pressure distributed as shown below:



passive pressure value in program for RETAINING WALLS

passive pressure value in program for FLOODWALLS

Because the wall is independently checked against sliding, there is no arbitrary limit applied to the passive pressure calculated in the overturning calculations. See the User's Reference Manual for more detailed information.

2-4-2 Without a key, the net horizontal unbalanced force is resisted by friction on the base, up to a value of

$$N \tan \phi + cA$$

where

N = resultant force normal to the base slab
ϕ = angle of sliding friction between the slab and the subgrade
c = adhesion between the slab and the subgrade, psf
A = base area in contact with the subgrade

Above this limit, the excess force is resisted by passive pressure as for a key.

2-5 SLIDING CALCULATIONS. Sliding calculations in the basic use of the program depend on the status of the key. Three conditions can be handled:

a. No key.

b. Key under the stem.

c. Key under the end of the heel.

See Chapter 10 of this user's guide and Chapter 4 of EMVE's documentation of the program specifications for more information on sliding computations.

2-6 Sliding for retaining walls is calculated according to Engineer Technical Letter 1110-2-256* using the shear-friction concept of the safety factor, being the ratio of resisting capability to driving forces. All external pressures are considered as driving forces. The minimum allowable safety factor in design (Module F3) is 2.0, which can be changed (see the User's Reference Manual).

2-7 Sliding for floodwalls is calculated according to the allowable soil strength procedures described in EM 1110-2-2101** using the multiple-plane failure surface shown in the diagram in Chapter 14. The allowable strengths are calculated according to

$$\tan \phi' = \frac{\tan \phi}{FS}$$

and

$$c' = \frac{c}{FS} + 2c'$$

where

ϕ = angle of internal friction in soil from tests
ϕ' = allowable angle of internal friction at equilibrium
c = test cohesive strength, tsf
c' = allowable cohesive strength, tsf
FS = trial factor of safety

FS is varied until a value is found to make the driving and resisting forces equal. The minimum allowable safety factor in design (Module F3)

* Headquarters, Department of the Army. "Gravity Dam Design--Stability," Washington, D. C.

** . 1948. "Flood Walls," with Change 3, 25 Jan 196 , Washington, D. C.

is 1.5, which can be changed (see the User's Reference Manual).

2-6 UPLIFT. Uplift is calculated by the line of creep method described in EM 1110-2-2501. Different creep path descriptions are used for the three purposes described below. Other methods are available (see the User's Reference Manual).

2-6-1 Overturning calculations are exactly as shown in EM 1110-2-2501. When the vertical resultant force lies outside the kern (resultant ratio less than one third or more than two thirds), only the effective portion of the base width (the portion in bearing contact) is included in the creep path and in sliding adhesion strength. The toe-side face of the key is always included in the creep path. Basic use of the program assumes that floodwalls have a vertical crack in the earth cover at the end of the heel and that retaining walls do not. See [illegible]'s documentation of the program specifications for illustration.

2-6-2 Sliding calculations of creep pressures are similar to those for overturning except that the creep path follows the failure surface under the neutral block. That is along the concrete-subgrade interface when there is no key and the maximum possible angle OMEGA is being considered. [illegible]

2-6-3 Soil-control creep ratio calculations in the basic use of the program use a creep path similar to that used for overturning. See paragraph 3-1-3 of the User's Reference Manual for more information on soil control capabilities. Basic use of the program reports the actual creep ratio but does not control it. For additional information, see the User's Reference Manual.

2-7 LOCATION OF VERTICAL RESULTANT FORCE. The vertical resultant force location is controlled during overturning stability design so that it is kept within the middle third (minimum resultant ratio 1/3) for load cases where the water level over the heel is more than 1.0 ft below the top of stem and within the middle half (minimum resultant ratio 1/4) for load cases where the water level over the heel is within 1.0 ft of the top of the stem.

2-8 GRAPHICS OUTPUT. Graphics output includes input data, resulting pressures, and member forces and moments. See Chapter 13 for details.

2-9 EARTHQUAKE EFFECTS. Earthquake effects are included in the calculations in IWDA but are beyond the scope of this user's manual. See the User's Reference Manual and [illegible]'s documentation of the program specifications for more information.

CHAPTER 3: PROGRAM ORIENTATION

3-1 GENERAL. When the user starts program TWDA running, it is in the command-data entry phase. After an initialization sequence of questions and answers, the program will accept either commands or data lists when the prompting message

```
COMMAND
?
```

is printed at the time-sharing terminal. When enough data lists have been entered to define the data required for a particular computation module, the command

```
RUN Module-Name
```

may be entered, to start the named module running. The data lists may be entered in any order so long as the items in each list are in the order prescribed for that list.

3-2 OPTIONS. There are four computation modules available in the basic use of the program:

Group	Module-Name	Action
Stability	FA	Foundation investigation
	FD	Foundation design
Stress	WA	Stress analysis
	WD	Stress design

In the basic use of the program, either module FA or module FD must have been completed with the message

```
#
# UPDATE FILE RESET
#
```

before module WA or WD will run.

3-3 "UPDATE" FILES. Each one of the programs in the three different groups uses computer files defined below:

3-4 "UPDATE" FILE. The update file must be new for a new program run. The name entered for this file must not already be in use. This file contains the execution, table, data and intermediate information for the program run at the last time the message

was printed at the user's time-sharing terminal. The file may be used only for future use with the REST command to restart after a program termination. It cannot be listed in time-sharing and can be created only by TWDA.

3-3-2 Data File. A data file contains data lists and commands that were typed and saved into a file instead of being entered interactively. It is created by the user before starting TWDA. This file is used as input only and is not updated or changed by the program. Its use is described in detail in Chapter 6.

3-3-3 Report File. The program creates a temporary report file that the complete output is written to (only a summary output is printed to the time-sharing terminal). When the user uses the END command to stop the program, he is given the options of directing the report file to a high-speed batch terminal, saving the file as a permanent file, or destroying the file. The user must be ready with a station code if he is running on the U. S. Army Engineer Waterways Experiment Station (WES) or Office of Personnel Management, Macon, Ga., (Macon), computers. The station code is obtained from the user's ADP Center. A saved permanent report file may not be used with the REST command or as a data file. All the user can do with it is list it at a terminal. See paragraph 4-7 for instructions on how to control the amount of information written to the report file.

CHAPTER 4: BASIC COMMANDS

4-1 GENERAL. These commands may be entered interactively after a

```
COMMAND
?
```

prompt or may be placed in a data file.

4-2 INIT COMMAND. INIT tells the program to set itself for a fresh start on a new problem and cancel all existing data values, if any. This command must be used in the program initialization sequence and may be used anytime to cancel all data previously entered.

4-3 REST COMMAND. REST tells the program to restore the data status set into an existing update file. This command cannot be used with an old report file or a data file.

4-3-1 The form of this command is

```
REST Old-File-Name
```

For example, if the name given to an update file of a previous program run were WPUT and if a later run were to be to restore the data and intermediate answers from that previous run, then the later run would use the command

```
REST WPUT
```

at the command prompt in the initialization sequence of the later run.

4-4 The most common use of this command is to pick up where an earlier program run ended. This permits a "recess" in the computer-aided design process. Such a recess might be to study the computations from one session prior to running the next module to be used, to redo an earlier module's computations, or to stop for any other reason.

4-5 UPDATE COMMAND. UPDATE tells the program to reset the update [illegible] paragraph 4-4-1). The normal use of this command is at [illegible] after entering data (see paragraph 5-1), just before [illegible] with the exit command. That way, if communication [illegible] computer interactions should cause a disconnect, the REST command [illegible] to full recovery.

4-6 [illegible] and the exact format:

[illegible]

LOOK Data-List-Name

causes a listing of the current values in the named data list, for all load cases, if applicable. For example, the command

LOOK SPH1

will cause the following information to be printed to the user's time-sharing terminal:

```
 DATA LIST    SPH 1
VARIABLE            VALUE              (LC)
PHI1       =        15.000               1
COH1       =        400.00               1
GAMAS1     =        125.00               1
DELTA1     =       0.                    1
PHI1       =        15.000               2
COH1       =        400.00               2
GAMAS1     =        125.00               2
DELTA1     =       0.                    2
HCMIN      = VALUE UNDEFINED

COMMAND
?
```

4-5-2 The command form

LOOK Module-Name

where "Module-Name" is FA, FD, WA, or WD, will cause the LOOK Data-List-Name command form to cycle through all of the LOOK Data-List-Name printings required to show the current status of all data that can be used by the module. Many of the data lists shown are described in this basic user's guide only in Chapter 12. See the User's Reference Manual for complete information.

4-5-3 The command form

LOOK ALL

will cause the LOOK Data-List-Name command form to cycle through all of the data variable lists used by the entire program. This can take almost 15 minutes to print at the time-sharing terminal.

4-5-4 The command form

LOOK XY

will cause a table of X- and Y-coordinates for the corners of the concrete outline to be printed, followed by the current values of all of the data variables that may be used to describe the outline. X-coordinates are positive toward the end of the heel from the toe-side face of the top of the stem (basic working point), and negative toward the end of the toe from the basic working point. Y-coordinates are elevations above some datum below the wall. Any one of the modules must have been executed (RUN) before this command will work.

4-6 RUN COMMAND. The command form

RUN Module-Name

starts the named module executing. This is entered after the data are ready. It is recommended that the UPDATE command be entered just before the RUN command, so that the program will be easy to restart if something happens while the module is executing. This command may be in a data file if the user does not need the summary output normally printed to the user's time-sharing terminal. Report file output is not affected.

4-7 TRCE COMMANDS. The command

TRCE 3

adds information to the report file. The command

TRCE 0

cancels this additional information and is in effect when the program is started running or after the LIT command is used. The following table furnishes guidance:

Purpose of Run	Do This
General design memo or survey report	After the END command, let the program destroy the report file. Do not use the TRCE 3 command
Feature design memo	Get the report file output, either at your ADP Center high-speed printer or as a permanent file. Do not use the TRCE 3 command
Contract plans files	Use the TRCE 3 command before the RUN command and get the report file

4-8 ? ENTRY. The ? requests information about commands and which data lists are associated with which modules (see paragraphs 5-4 and 5-5). See paragraph 5-3-4 for other use of the ? entry.

4-9 END COMMAND. END tells the program to stop execution after asking the user for instructions on what to do with the report file. Have a station code (get it from your ADP Center) ready to enter when requested, if using the computers at WES or Macon. See also paragraph 3-3-3.

4-10 OTHER COMMANDS. Other commands are described in the User's Reference Manual.

4-11 COMMAND ERROR RECOVERY. Many of the commands have procedures built in for using question and answer sequences to recover from illogical or unexpected supplemental information. These sequences are not shown in this user's guide but are believed to be self-explanatory. A response of END will end the run; a null response (just a carriage return) will return to the COMMAND ? prompting message.

CHAPTER 5: DATA LIST RULES

5-1 GENERAL. A data list is a line of input containing the name of the list, then one or more blanks, then the data items in the list, separated by one or more blanks. Do not use any commas. Data lists may be used to edit (change) as well as to enter data. The first use of a particular list will define values for the input variables in the list. A later use of the same list, for the same load case if LC is in the list, will substitute new values. Data lists may be entered interactively, or they may be on one line of a data file.

5-2 LOAD CASE NUMBER. Many of the data lists have a variable called "LC." This means, with occasional specially labeled exceptions, that the rest of the items may have different values for different load cases. Entering a load case number of zero will designate the rest of the list to be for all possible load cases. For example, the data list SPT7 contains the variables LC, PH17, COH7, and GAMAS7, in that order. The data entry lines

```
SPT7   0  25   500  125
SPT7   2  20   600  120
```

would result in the following values being used by the program:

Load Case	PH17	COH7	GAMAS7
1	25	500	125
2	20	600	120
3-10	25	500	125

while the lines

```
SPT7   2  20   600  120
SPT7   0  25   500  125
```

would result in all 10 load cases using the values

PH17	COH7	GAMAS7
25	500	125

5-3 SPECIAL IDENTIFIERS. Special identifiers D, S, C, and ? may be used for any data variable except load case (LC), reinforcing steel layer number (LN, LNA, or LNB), and location code (LOC). (These letters are used in a data list instead of the numeric value.)

5-3-1 Special identifier D (default) will instruct the program to insert the default value. Some data variables have more than one default

value, depending on the user's answers to questions in the program run initialization sequence. If the data value is printed before the default value is inserted, it may show as the number -0.1432E30 or as the message "DEFAULT VALUE REQUESTED."

5-3-2 Special identifier S (same) tells the program to not change whatever value that data variable already had. This is used when data are being edited by re-entering a data list, to skip having to retype the numbers that are not to be changed.

5-3-3 Special identifier C (calculate) is used to tell the program to calculate the value from other data. This has two purposes:

a. To designate which one of several items in a mutually interdependent data set is to be calculated from the other values in the set. For example, the data set for defining the toe width (TW2), stem location (STR), stem base thickness (TSTB), and heel width (HEELW) must have one of the following sets of values in proportioning the base for analysis (modules FA or WA). Any two of the four items (TW2, STR, TSTB, HEELW) must be defined. The other two, if defined, must be consistent within 0.01 ft.

Set Number	TW2	STR	TSTB	HEELW	To Be Calculated
1	value	C	C	value	STR, TSTB
2	value	C	value	C	STR, HEELW
3	C	value	C	value	TW2, TSTB
4	C	value	value	C	TW2, HEELW

These items are found in data lists WLA and WLAS for analysis or in data list WLD for design.

b. To tell modules FA or FD whether to use an input value of the active earth pressure coefficient or to calculate it from the internal friction angle PHI1 and the stem face batter and backfill soil surface slope. If the calculation is wanted, use the letter C for RKA1. Use the desired value for RKA1 if that specific value is to be used.

Variables identified with a C are calculated in different parts of the program. If the variable's value is printed before the calculations are completed by the program, it may show as the number -0.1234E30 or as the message "VALUE NOT DEFINED."

5-3-4 Special identifier ? indicates that the user wants information about the definition or units of the data variable(s). The action will be like this:

```
COMMAND
?WLD  100.0  10.0  ?   C  D  S
```

```
VARIABLE        UNITS     -   DEFINITION
  STR           RATIO         STEM RATIO (TOE WIDTH TW2/BASE WIDTH BW)

TRY AGAIN ENTER VALUE FOR - STR
?
```

The kind of information available with repeated use of the ? response depends on the location in the program of the prompting or question being responded to. If ? is repeated where additional prompting is not available, the program will repeat the input request.

5-4 REQUESTING PROMPTING ABOUT A PARTICULAR DATA LIST. Entering only the name of a data list without anything else after it will cause the program to print out a description of what data variables are included in the list and what their definitions and units are.

5-5 REQUESTING PROMPTING ABOUT WHAT DATA LISTS ARE USED BY WHICH MODULE. Entering ? as a command will cause printing of the names of all data lists that are required and optional for all modules. This prompting will name data lists that are not described in this basic user's guide. See the User's Reference Manual for complete information. This list of modules and their associated data list names will be followed by a table of all of the commands and their functions. See Chapter 12 for a list of all data lists.

5-6 Omitted data lists are assumed by the program to contain all D's or C's, as appropriate to the type of variable.

5-7 Truncated data lists (where only part of the list is entered) are assumed to have all of the missing values after the furnished values and to have D's or C's for all of the missing values, as appropriate to the type of variable.

CHAPTER 6: DATA FILES

6-1 CONTENT. A data file, sometimes called a command-data file, contains the two sections described below. Each line of the file is made up of a line number followed by one or more blank spaces, then either a command and its supplemental information (see Chapter 4) or a data list (see Chapter 5).

6-1-1 Part 2 of the program run starting sequence described in paragraph 7-3:

a. For a new run:

```
1000 INIT
1010  1
1020  F
1030  H
```

b. For a restart of an old run that had its update file named EDCS2:

```
1000 REST EDCS2
```

6-1-2 As much of the rest of the program input as desired. This normally includes the input data lists followed by the UPDATE command. It may, however, include all of the rest of the run including the END command. But see paragraph 6-3.

6-2 END OF DATA FILE. There are two ways to end a data file: by using the END command or just letting it run out of commands and data lists. It is strongly recommended that the last line be the UPDATE command to reset the update file so that it will contain the data in the file. It is much faster to restore from an old update file than to reread a data file.

a. Letting the data file run out without END on the last line will cause printing of the message

```
#
#DATA FILE PROCESSING DONE
#
#RETURN TO INTERACTIVE INPUT
#
```

before the command prompt

```
COMMAND
?
```

b. The END command in the last line will cause a normal program termination with report file destination questions and answers. Be careful to have the RUN commands or at least an update command before the END command, or the program run is wasted. Placing the END command in a data file eliminates the user's capability to edit data and rerun a module while the program is still running.

6-3 EFFECT ON OUTPUT. Much output that would normally be printed to the time-sharing terminal as well as to the report file is printed only to the report file when the program is running from a data file. This may or may not be a problem to the user, depending on the circumstances of the program run. If answers are needed as soon as possible, the user should end his data file just before the first RUN command. If minimum operator time is important and the engineer can wait for the report file from his ADP Center, then the RUN commands should be in the data file.

6-4 DATA ERROR RECOVERY. An invalid data list line or command will cause one of several interactive error recovery procedures, one of which is illustrated below:

a. Data list line no. 1080 with too many items:

```
1080  CASE  2  1  3  4
```

b. Error recovery:

```
### ERROR IN DATA FILE-RETURN TO KEYBOARD ### BAD LINE FOLLOWS:

CASE  2  1  3  4

TOO MANY VALUES ENTERED IN DATA LIST - CASE
COMMAND IGNORED - TRY AGAIN
?CASE  2  1  3
```

c. Control returned to the data file after the corrected line was typed in. If the user had typed the command KEY instead of the corrected data list, control would have remained with the keyboard, and the erroneous line and the rest of the data file would have been ignored. Note that the line number was not reentered, just the data list. Similarly, with a misspelled command word or missing supplemental information.

CHAPTER 7: STARTING A PROGRAM RUN

7-1 GENERAL. The beginning portion of a run can follow any of several scenarios, depending on whether a data file is to be used and whether the INIT or REST commands are used. See paragraph 6-1 for the meaning of "data file." A data file is not the same as an update or a report file.

7-2 STARTING SEQUENCE, PART 1. The update file in this example is to be named "WP07091"; the report file is to be identified by "WESKD-WAP."

```
PROGRAM TWDA -- 713-F3-R0- 027

    T-WALL DESIGN/ANALYSIS

        REL 1.0   JAN 79


(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?WP07091


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?WESKD-WAP
ENTER YOUR MACON ACCOUNT NUMBER
?BBBBBBB



ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIABE RETURN IF COMMANDS ARE TO BE
ENTERED INTERACTIVELY
?
```

7-3 STARTING SEQUENCE, PART 2. Part 2 of the starting sequence depends on the answer to the last question of part 1. Three options are available, each option ending with the program ready to accept data lists and commands:

a. Data file used, with last line in the file not containing END command (the data file used in this example was named "XIBITX"). The data file must contain the rest of the program initialization sequence (see paragraph 6-1).

```
ENTER NAME OF COMMAND-DATA FILE OR
```

```
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE
ENTERED INTERACTIVELY
?XIBITX
PROCESSING DATA FILE ...


END OF FILE ON COMMAND DATA FILE
RETURN TO KEYBOARD ENTRY.

COMMAND
?
```

b. Data file not used; all input to be interactive at the keyboard. In this example, this is a new start, there will be one load case, and the wall is a hydraulic floodwall:

```
ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE
ENTERED INTERACTIVELY
?

IS THIS AN INITIAL RUN OR A RESTART OF A PREVIOUS RUN?
ENTER 'INIT' OR 'REST'

COMMAND
?INIT

#- ALL DATA RESET FOR FRESH START -#
ENTER NUMBER OF LOAD CASES (1 TO 10)
?1

-
IS THE WALL GENERALLY A FLOOD WALL OR A RETAINING WALL?
ENTER 'F' OR 'R'
?F
IS STRUCTURE HYDRAULIC OR NON-HYDRAULIC?
ENTER 'H' OR 'N'
?H

COMMAND
?
```

c. Data file not used; a restart of a previous run. In this example, the file being restarted from is named "WAP1101":

```
ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE
ENTERED INTERACTIVELY
?
```

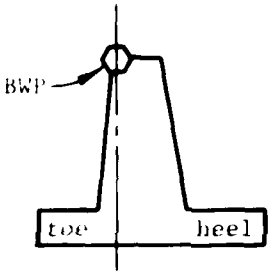
```
IS THIS AN INITIAL RUN OR A RESTART OF A PREVIOUS RUN?
ENTER 'INIT' or 'REST'

COMMAND
?REST WAP1101

#- ALL DATA RESET FOR FRESH START -#
#- COMMON DATA RESET FROM RESTART FILE WAP1101 , UPDATE FILE RESET -#

COMMAND
?
```

[illegible]

[illegible] Input Data Lists. There are two types of data [illegible] are optional. All of the required data lists [illegible] a model will run properly. As many of the optional [illegible] are needed to set data input values to what [illegible] to the default values. An omitted optional list [illegible] all "zeros", as appropriate (see paragraphs 5-3 and [illegible]

[illegible] Coordinates:

a. [illegible] Back Setting Point (BSP) is the toe side of the top of [illegible] toe. A vertical plane through the BSP forms the horizontal reference for locating surcharges and earth surfaces.



b. Elevations are above some datum that must be at or below the wall.

c. Data variable LC, if included in a data list, is the load case number to which the values in the list apply. See paragraph 5-2 for more information.

d. All units are feet unless otherwise noted.

e. All forces and pressures are positive when they tend to move the wall (1) in the direction of the end of the toe or (2) downward.

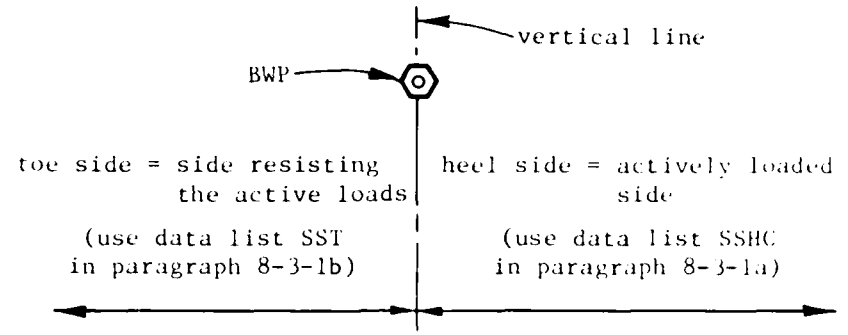
8-1-3 Data List Preparation Sequence:

a. The order in which a group of data lists is entered is generally immaterial as long as the individual items in any one list are in the order shown for that list. Note, however, that entering the same list more than once will have the effects described in paragraphs 5-1 and 5-2.

b. A suggested sequence for entering the data list for basic program use is to define the following things in the order shown, after completing the starting sequence described in Chapter 7:

(1) Soil surfaces:

(a) The desired finished grade cross section, based on project requirements, using data lists SST and SSHC to define the soil surfaces:



(b) The existing grade cross section soil surface, using data list SSEE in paragraph 8-3-2 and Figures 8-1 and 8-2. This list is required only if quantities are to be figured for structural excavation and backfill.

(2) Soil properties:

(a) Subgrade; may also be used for backfill as described in paragraph 8-4-2. Use data list SPE3 in paragraph 8-4-1.

(b) Heel backfill, only if different from subgrade soil data list SPE3. Use data list SPH1 in paragraph 8-4-2a.

(c) Toe backfill, only if different from subgrade soil data list SPE3. Use data list SPT7 in paragraph 8-4-2b.

(3) Water elevations, if any, using data list SEEP in paragraph 8-6-1 if there is any water on the wall.

(4) Surcharges and direct forces, if any, using the data lists described in paragraph 8-7 and Figure 8-3.

(5) Wall geometry, using the data lists described in paragraph 8-8 and Figures 8-4 and 8-5.

(6) If the problem includes stress analysis of an existing wall, code the reinforcing steel description using the data lists described in paragraph 8-9. If the problem includes stress design, use the information in paragraphs 8-9-2 through 8-9-4 to interpret the output.

(7) If the problem includes stress design, read and follow paragraph 8-10.

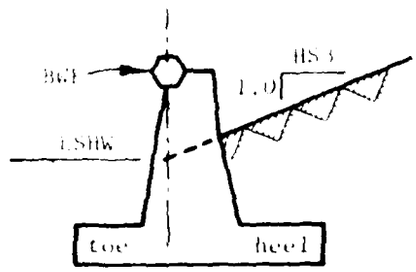
(8) If data list SSFI has been used to define an existing soil surface, then the data lists described in paragraph 8-11 may be used to define unit costs.

8-2 SUMMARY OF DEFINITIONS. See Chapter 12 for a summary of the contents of all data lists, arranged in alphabetical order.

8-3 SOIL SURFACE. Data lists beginning with the letters SS:

8-3-1 Sloping Backfill Data Lists SSBC and SSHC:

a. SSBC (soil surface over the heel). Data list SSBC defines the finished backfill grade over the heel for use in computation of active earth pressures.



NOTES: The soil surface must touch the heel-side face of the stem, below the top and above the bottom.

Slope HS3 is positive upward leaving the wall; negative if downward.

HS3 = 100.0 if level.

SSHC LC ESHW HS3

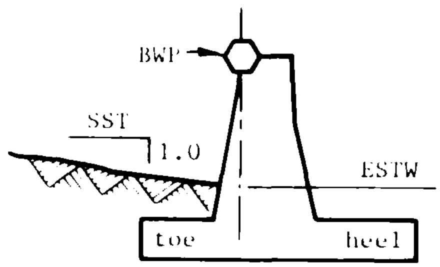
SSHC = name of list: soil surface on heel side of toe, for earth pressures.

LC = load case number. See paragraph 8-1-2.

ESHW = elevation of surface where the slope intersect a vertical line through the BKF. No default value.

HS3 = slope of finished grade over the heel. 100. if level. No default value.

b. SSI (soil surface over the toe). Data list SSI defines the finished backfill grade over the toe:



NOTES: Slope SST is positive upward leaving the wall; negative if downward.

SST = 100.0 if level.

SST LC ESTW SST

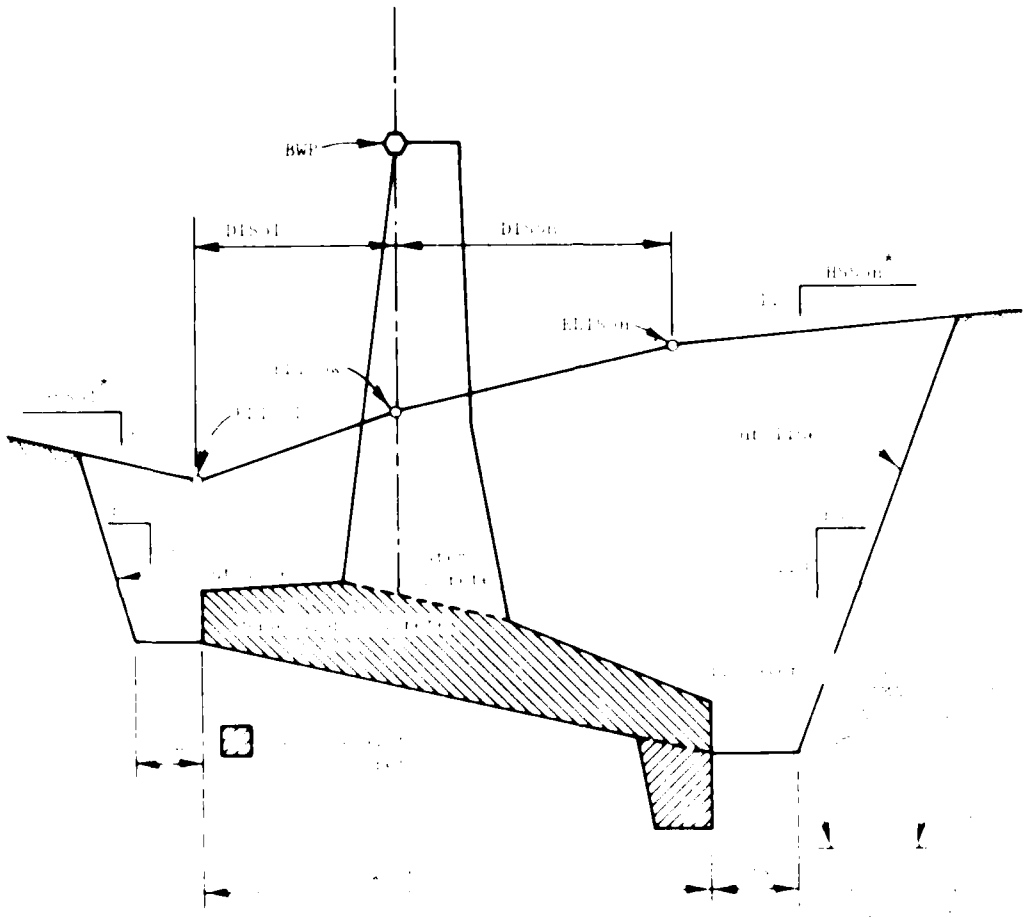
SST = name of list: soil surface on toe side of stem

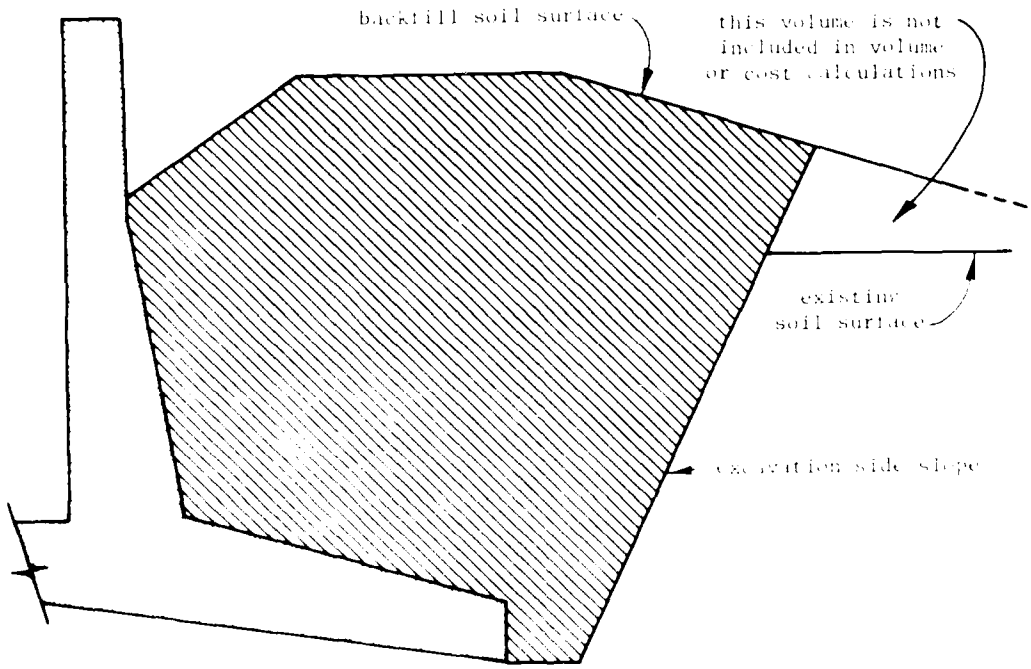
LC = load case number

ESTW = elevation of surface where the slope intersects a vertical plane through the BWP. No default value.

SST = slope of finished grade over the toe. 100. if level. No default value.

[illegible] Soil Surface Data List SSEE (Soil Surface of Existing [illegible] Structural Excavation). This list is optional and [illegible]


BWP


backfill soil surface
this volume is not
included in volume
or cost calculations
existing
soil surface
excavation side slope

ELTS5W = elevation of existing ground under basic working point

ELTS5H = elevation of existing surface at a distance DTS5H on the heel side from the BWP, feet. Default = same as ELTS5W

DTS5H = horizontal distance from the BWP to ELTS5H, feet. Default = 0.0

HSS5H = existing surface slope beyond distance DTS5H, heel side, feet horizontal per foot vertical, 100.0 = level. Positive upward leaving the stem. Default = 100.0

8-4 SOIL PROPERTIES. Data Lists beginning with SP:

8-4-1 Required Data List SPE3 (Soil Properties of Existing Soil). This data list is not load case dependent. It defines the subgrade soil plus backfill earth if not separately defined:

SPE3 PHI3 COH3 GAMAS3 PHIS3 ADHS3 ABP3TN ABP3BN ABP3TW ABP3BW ELBS3

SPE3 = name of list

PHI3 = angle of internal friction, degrees. No default value.

COH3 = cohesive strength, psf. No default value.

GAMAS3 = unit weight, including weight of water if submerged, pcf. No default value

PHIS3 = maximum angle of friction along soil-concrete interface for sliding on subgrade, degrees

ADHS3 = adhesive strength along soil-concrete interface for sliding, psf

(NOTE: The rest of this list may be omitted if bearing pressure is not to be checked.)

ABP3TN = allowable bearing pressure under a wall with base width = BW1 (narrow base) as defined in paragraph 8-8-4, psf, at the top of this soil (no overburden). No default value

ABP3BN = allowable bearing pressure under a wall with base width = BW1 (narrow base), psf, at the bottom of existing soil, including weight of overburden. (At elevation ELBS3.) No default value

ABP3TW = allowable bearing pressure under a wall with base width = BW2 (wide base), psf, at the top of this soil. No default value

ABP3BW = allowable bearing pressure under a wall with base width = BW2 (wide base), psf, at the bottom of existing soil, including weight of overburden. (At elevation ELBS3.) No default value

ELBS3 = elevation of bottom of soil layer 3, feet. Basis for ABP3BN and ABP3BW. Default = 10 ft below the lowest concrete elevation

8-4-2 Optional Data Lists:

a. Data list SPH1 (soil properties of heel backfill, layer number 1). This list is not needed for a particular load case if the following conditions are true for that load case:

(1) The basic properties of internal friction angle, cohesion, and saturated earth unit weight are the same for the heel backfill as for the subgrade data list SPF1.

(2) The user is willing to use the default values shown below for data variables RKA1, DELTA1, RKAE1, and HCMIN:

Data Variable	Units	Default Value
RKA1	ratio	C (see paragraph 5-3-3)
DELTA1	degrees	0.0
RKAE1	ratio	C
HCMIN	feet	3 + 0.1[ETS - ESHW(LC)] ≥ 5.0

The default values listed below are applicable when SPH1 is used for a particular load case or all load cases:

SPH1 LC PHI1 COH1 GAMAS1 RKA1 DELTA1 RKAE1 HCMIN

SPH1 = name of list

LC = load case number for this set of values

PHI1 = angle of internal friction, degrees. Default = 0.0

COH1 = cohesive strength, psf. Default = 0.0

GAMAS1 = unit weight, including weight of water if submerged, pcf. No default value

(NOTE: The list may be truncated here.)

RKA1 = horizontal active earth pressure coefficient. Will be used instead of Coulomb calculations based on PHI1, DELTA1, and stem face batter, if defined. Use of the letter C as the value will cause it to be calculated. Default = C

DELTA1 = wall friction angle for Coulomb's equation for active earth pressure coefficient, degrees. See RKA1 above. Default = 0.0.

RKAE1 = Mononobe-Okabe earthquake active earth added pressure coefficient. Will be calculated from RKE and RKV in data list SOLP if the letter C is used as a value for RKAE1

HCMIN = minimum earth backfill cover over the heel, feet. Used only by module FD. Default = 3 + 0.1[ETS - FSHW(LC)] 5.0. This is the only data variable in this list that is not load case dependent

b. Data list SPT7 (soil properties of toe backfill, layer number 7). This list is not needed for a particular load case if the data for internal friction angle (PHI3), cohesion (COH3), and saturated unit weight (GAMAS3) of data list SPT3 are also valid for the toe earth backfill, for that load case. The default values listed below are applicable when SPT7 is used for a particular load case or all load cases:

SPT7 LC PHI7 COH7 GAMAS7

SPT7 = name of list

LC = load case number for this set of values

PHI7 = angle of internal friction, degrees. Default = 0.0

COH7 = cohesive strength, psf. Default = 0.0

GAMAS7 = unit weight, including weight of water if submerged, pcf. No default value

8-5 FOUNDATION RESISTANCE PARAMETERS

8-5-1 Optional Data List SOLP (Soils Design Parameters). This list contains the major stability design/analysis control parameters. It is described in detail in the User's Reference Manual and is not needed for basic use of the program. The summary definitions in this user's manual are included only to show the possible versatility of the program. Chapter 2 describes the programmed action when data list SOLP is not used:

SOLP LC IFWOC NODE IFSOM NPPD RKH RKV CFMA

SOLP = name of list: soil design parameters

LC = load case number for this set of values

IFWOC = wedge method or Coulomb's method for active earth pressures

NODE = how many nodes are used to specify active earth pressures

IFSOM = wedge method control parameter

NPPD = passive pressure diagram shape control for overturning calculations

RKH = earthquake horizontal acceleration factor

RKV = earthquake vertical acceleration factor

CFMA = correction factor for active earth pressure moment arm, to include arching active

8-5-2 Optional Data List RRD (Used in Module FD Only). This list controls the limits placed on resultant vertical reaction force location in the foundation stability design calculations. It is described in detail in the User's Reference Manual and is not needed for basic use of the program. The summary definitions shown in this user's manual are included only to show the possible versatility of the program. Paragraph 2-7 describes the programmed action when data list RRD is not used:

RRD LC RRMIN

RRD = list name: resultant ratio for design

LC = load case number for this value of RRMIN

RRMIN = minimum allowable resultant ratio for stability design

8-6 WATER. Both of these lists are optional, so go on to paragraph 8-7 if there is no groundwater or pool.

8-6-1 Required Data List SEEP. The first three variables in data list SEEP define water elevations; most of the other data variables in this list are beyond the scope of this basic user's guide. Only the names of the variables are shown herein. See the User's Reference Manual for information on these variables concerning alternate methods for determining seepage pressures:

SEEP LC ELWT ELWH HGSW ISLC ISFT KRACK

SEEP = list name

LC = load case number for this set of values

ELWT = elevation of water on the toe side of the stem, feet. Default = C for "no water"

ELWH = elevation of water on the heel side of the stem, feet. Default = C for "no water"

(NOTE: The list may be truncated here.)

HGSW = use a value of C

ISLC = use a value of C

ISFT = use a value of C (for line of creep method)

KRACK = use a value of C. The programmed action is described in Chapter 2

8-6-2 Optional Data List BOIL. This controls calculation of the boil control creep ratio. The list is described in detail in the

User's Reference Manual and is not needed for basic use of the program. The summary definitions shown herein are included only to show the possible versatility of the program. Paragraph 2-6-3 describes the programmed action when data list SOLP is not used:

BOIL ELSPT CRMIN IPATH

BOIL = list name

ELSPT = elevation of tip of impervious sheet pile below the key or at the end of the heel if there is no key

CRMIN = the value of average creep ratio to be used in calculating the highest allowable cutoff wall tip elevation. Default = C for "no cutoff wall"

IPATH = use C or 1 for this item. See the User's Reference Manual for more information

8-7 SURCHARGES AND DIRECT FORCES ON WALL

8-7-1 All Surcharge Data Lists Are Optional:

a. Surcharge data lists SCFD, SCFH, and SCWH may be used in Modules WA and WD.

b. Surcharge data lists SCFV and SCWV are not used by Modules WA or WD.

8-7-2 Data Item Definitions. See Figure 8-3 and paragraphs 5-6 and 5-7:

List Name	Variable Name	Units/ Values	Default Value	Definition (See Note 1)
SCFD				Vertical forces on concrete
	LC	0,1-10	1	Load case number
	PVS	lb/ft	0.0	Line load centered on top of stem
	PVB	lb/ft	0.0	Line load on base slab at X-coordinate value DVB from vertical line through the BWP
	DVB	ft	0.0	X-coordinate from BWP to PVB. Negative if PVB is on toe
SCFH				Horizontal forces on concrete
	LC	0,1-10	1	Load case number
	PH1	lb/ft	0.0	Line load at elevation ELPH1. Must be negative if on toe

(Continued)

8-7-2 Data Item Definitions (Continued):

List Name	Variable Name	Units/ Values	Default Value	Definition (See Note 1)
SCFH	ELPH1	ft	--	Elevation of force PH1. May be at any elevation on or above bottom of toe
	PH2	lb/ft	0.0	Line load at elevation ELPH2
	ELPH2	ft	--	Elevation of force PH2. Must be above base; on stem only
SCFV				Vertical line loads on soil surface
	LC	0,1-10	1	Load case number
	PV1	lb/ft	0.0	Line surcharge at X-coordinate DV1
	DV1	ft	0.0	X-coordinate at line load PV1. See note 2
	PV2	lb/ft	0.0	Line surcharge at X-coordinate DV2
	DV2	ft	0.0	X-coordinate at line load PV2
	PV3	lb/ft	0.0	Line surcharge at X-coordinate DV3
	DV3	ft	0.0	X-coordinate at line load PV3
	PV4	lb/ft	0.0	Line surcharge at X-coordinate DV4
	DV4	ft	0.0	X-coordinate at line load PV4
	PV5	lb/ft	0.0	Line surcharge at X-coordinate DV5
	DV5	ft	0.0	X-coordinate at line load PV5
SCWH				Horizontal pressures
	LC	0,1-10	1	Load case number
	W1	psf	0.0	Pressure on any portion of stem above finished grade
	ELW1T	ft	--	Elevation of top of W1. Must be between the top of stem and ELW1B
	ELW1B	ft	--	ELevation of bottom of W1. Must be below ELW1T
	W3	psf	0.0	Pressure at finished grade elevation over end of heel. See note 2

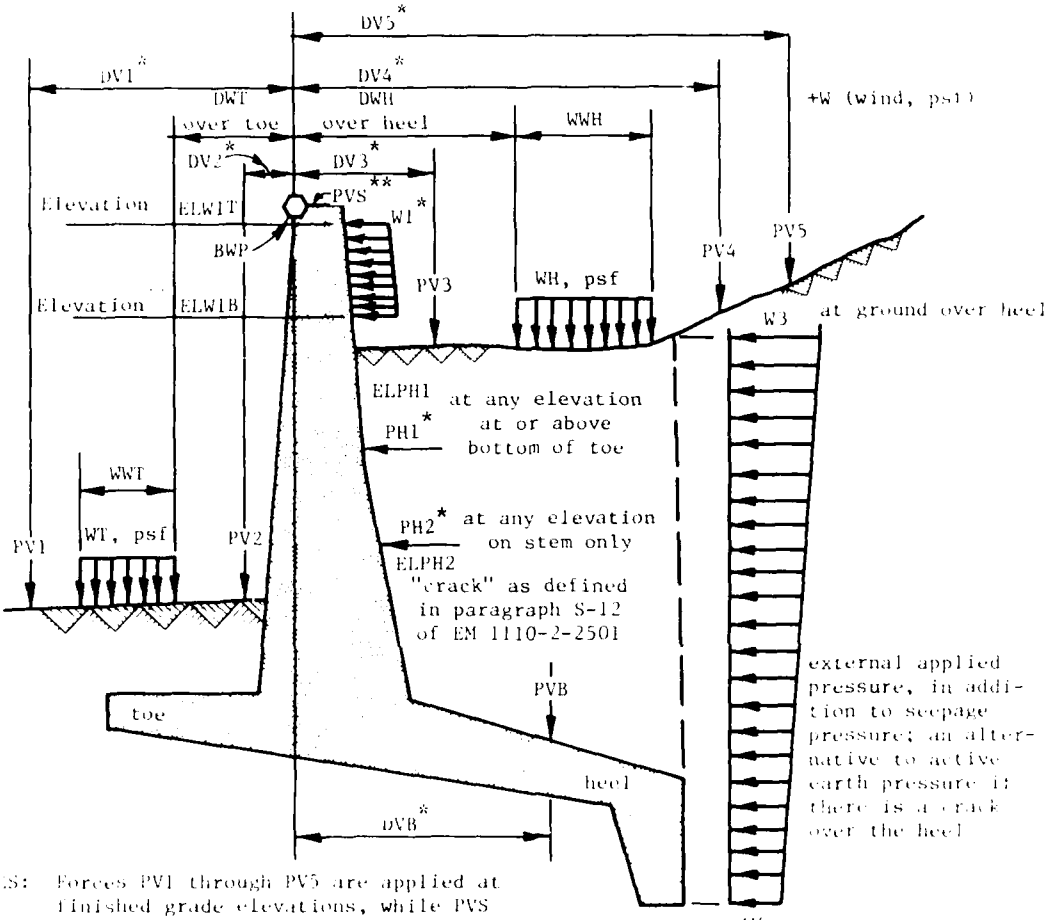
(Continued)

8-7-2 Data Item Definitions (Concluded):

List Name	Variable Name	Units/ Values	Default Value	Definition (See Note 1)
SCWH	W4	psf	0.0	Pressure at bottom of key if key is at end of heel (KFLAG = 0) or at bottom of end of heel if no key or if key is under the stem (KFLAG is positive)
SCWV				Vertical surcharge pressures on soil surface
	LC	0,1-10	1	Load case number
	WT	psf	0.0	Area surcharge, over a portion of toe only
	WWT	ft	0.0	Width of WT
	DWT	ft	0.0	Horizontal distance from basic working point to stem-side edge of area covered by WT. Always entered positive; over toe only
	WH	psf	0.0	Area surcharge, over a portion of heel only
	WWH	ft	0.0	Width of WH
	DWH	ft	0.0	Horizontal distance from basic working point to stem-side edge of area covered by WH. Always positive; over heel only
WIND	LC	0,1-10	1	Load case number
	W	psf	0.0	Wind pressure (+ from heel, - from toe) on exposed surface of stem not covered by pressure W1 in data list SCWH

NOTES: (1) All forces and pressures are positive downward or acting toward the toe from beyond the heel.

(2) Used only for flood walls, ignored for retaining walls. Pressures W3-W4 are in addition to all seepage pressures; they are intended for use to model the momentary increase in hydrostatic pressure caused by the rise in mean water level as a wave approaches the stem. Pressures W3-W4 act instead of active earth on the neutral block for floodwalls in the basic use of the program.



NOTES: Forces PV1 through PV5 are applied at finished grade elevations, while PVS and PVB are applied directly to the concrete.

All forces and pressures are shown acting in the positive direction.

* Any value can be used, on either side of the stem (either direction); positive if over heel, negative if over toe.

** Centered on top of stem.

At or below top of stem.

Below ELWIT; may be below ground (must be on stem).

Figure 8-3. Illustration of applied loads and surcharges

8-8 WALL GEOMETRY DATA

8-8-1 Internal Coordinate System. A system of orthogonal coordinates is calculated internally and used to define locations of corners of the concrete outline, as well as of the soils system and sliding failure planes. See the circled numbers in Figure 8-4.

a. X-coordinates are measured horizontally from an origin along the Y-axis which runs vertically through the BWP. Positive values are toward the heel; negative values are toward the toe.

b. Y-coordinates are elevations. All values must be positive.

8-8-2 Data Redundancy. The data items are more than sufficient to describe a wall. This redundancy gives the user more flexibility in how a wall can be described, or verifies the consistency of a description calculated elsewhere. Major redundant data sets are described below:

a. Stem location on base. The location of the stem (toe side of stem at base) can be established by defining any one of the following sets of data. See paragraph 8-8-4 for definition of the variables. It is assumed that the base width (BW) has already been established (See also paragraph 5-3-3a):

(1) TW2 (toe width).

(2) BW, STR (BW times stem ratio).

(3) TSTB, HEELW (toe width is remainder of BW).

b. Heel thickness at stem. The possibilities here are based on the fact that the program always completes the definition of the toe width and thicknesses first. Alternate sets are listed below:

(1) Toe description, IBSAME = 1, HEELT2.

(2) HELT1, HEELT2.

HEELT2 is set to its default value of TMINB if undefined. TMINB is determined from the following rules if undefined. HEELT1 and HEELT2 cannot be less than TMINB; TMINB must be entered if it is to be less than the default value:

ETS - BTEI	TMINB and TMINS Default Values
< 15.0 ft	12.0 in.
≥ 15 ft	18.0 in.

c. Heel-side bottom panel batter of stem. This value (HSBPB) is always calculated by the program as it closes the perimeter description of the wall cross section. The calculated value is printed in the report file.

8-8-3 Data Lists. Many of the wall geometry data items appear in more than one list to aid the user in entering the fewest number of lists possible. In general, there are two types of lists: those describing the wall for analysis, and those describing the wall for design. The first two letters of the list names are "WL" for "wall." The third letter is either "A" for "analysis" or "D" for "design." The fourth letter, if used, is "B" for "base," "H" for "heel," "K" for "key," "S" for "stem," or "T" for "Toe."

a. Lists for analysis

*WLA ETS TW2 STR HEELW

*WLAB BW BW1 BW2 BS

*WLAH HEELT2 HEELW HEELT1

WLAK KFLAG DKEY WKEY BKTF

*WLAS TSTT TSB TSTB HSTPH HSTPB HSBPB

*WLAT BTE1 TOEHT TS2 TW1 TS1

WLBR BASER

b. Lists for design

*WLD ETS TW2 STR HEELW TSTB TMINB

*WLDB BW1 BW2 BS1 BS2 (needed only for stability design)

WLDH HEELT2

WLDK KFLAG BKTF DKEY1 DKEY2

WLDS TMINS TSB HSTPH HSTPB HSBPB

*WLDT BTE11 BTE12 TOEHT TW1

WLBR BASER

Note that TMINB in list WLD must be used for slab thicknesses below the default for TMINB and TMINS in list WLDS must be used for stem thickness less than the default for TMINS. Note that this list may not be terminated after TMINS because the rest of the list must be "S," not "D."

* Denotes a required list.

8-8-4 Data Item Descriptions. (See Figure 8-4.) Wall parameters are listed in the approximate order that they are used in the program.

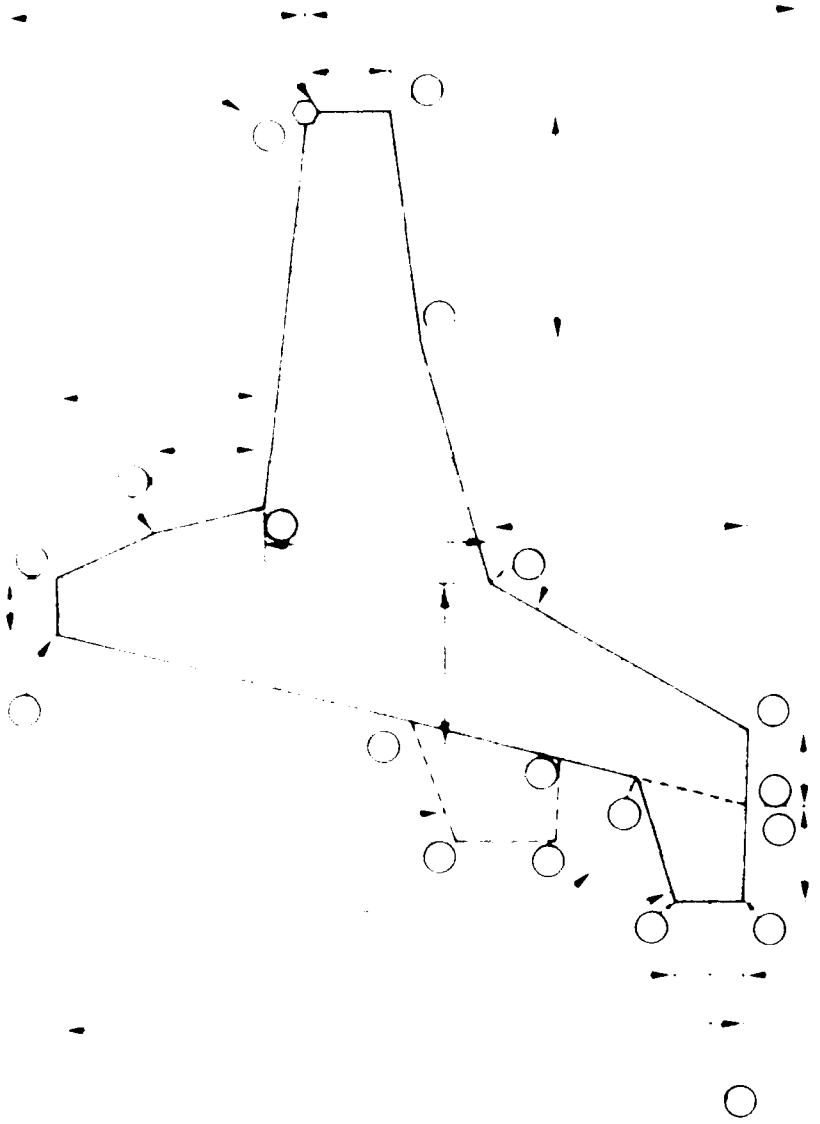
Variable Name	Units	Default Value	Definition
			Stem Description
TSTT	in.	TMINS	Stem thickness at top. See note 1.
ETS	ft	(1)	Elevation of top of stem
TSB	in./ft	0.0	Toe-side batter, inches horizontal per foot vertical
TSTB	in.	(10)	Stem thickness at base. See note 11
TMINS	in.	(3)	Minimum allowable stem thickness. See paragraph 8-4-2(2)
HSTPH	ft	(2)	Heel-side top panel height. Enter 0.0 if no top panel. See note 1
HSTPB	in./ft	0.0	Heel-side top panel batter, inches horizontal per foot vertical. See note 1
HSBPB	in./ft	(3)	Heel-side bottom panel batter, inches horizontal per foot vertical. (Must not be a bottom step thickness at the horizontal projection). See notes 12 and 13
			Toe Description
TW1	ft	0.0	Width of part 1 of toe (at step)
TS1	ratio	100.0	Slope of top of part 1 of toe, 1.0 vertical to TS1 horizontal, 100.0 = level. Must always be positive
TW2	ft	(4)	Width of entire toe. See note 10
TS2	ratio	100.0	Slope of top of part 2 of toe (at end), 1.0 vertical to TS2 horizontal, 100.0 = horizontal. Must always be positive
TOEBT	in.	TMINB	Toe thickness at end. Always vertical. See note 12
BTE1	ft	(1)	Elevation of bottom of toe at end
BTE11	ft	(1)	Lowest value of BTE1 in module FD
BTE12	ft	(5)	Highest value of BTE1 in module FD
STR	ratio	None	Stem ratio (Design value for TW2/BW)

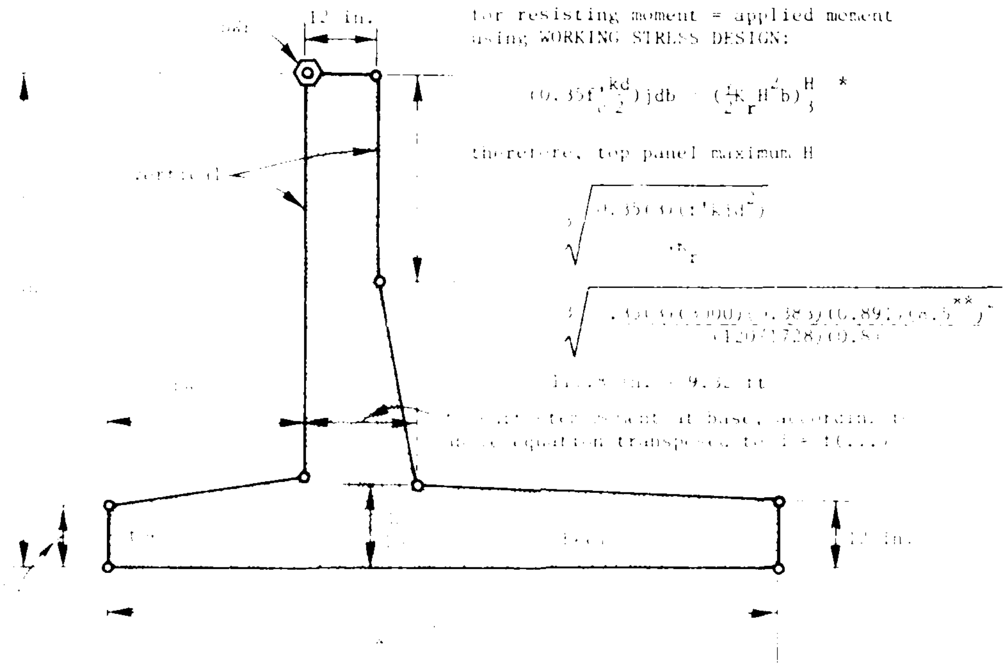
(Continued)

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	ft	[illegible]	[illegible]
[illegible]	ft	[illegible]	[illegible] interpolation [illegible]
[illegible]	ft	[illegible]	Maximum value for [illegible] in module [illegible]. Also needed for allowable bearing [illegible] interpolation in modules [illegible] and [illegible]. Must be larger than [illegible]
BS	ratio	[illegible]	Base bottom slope, BS vertical to 1.0 horizontal, 0.0 = level
BS1	ratio	[illegible]	Minimum value for BS in module FD
BS2	ratio	[illegible].3333	Maximum value for BS in module FD
[illegible]	ft	[illegible]	Base horizontal radius defining trapezoidal plan, measured from basic working point, positive over heel. Base is always 1.0 foot wide under the basic working point. 0.0 = rectangular (infinite radius)
TMINB	in.	(3)	Minimum allowable base slab thickness. See paragraph 8-8-2b(2)
			Key Description
KFLAG	0 or 1	1	0 if key is at end of heel; 1 if key is under stem
DKEY	ft	0.0	Key length, measured vertically along heel side
DKEY1	ft	0.0	Minimum value for DKEY in module FD
DKEY2	ft	(3)	Maximum value for DKEY in module FD
BKTF	ratio	3.0	Toe-side face batter, 1.0 horizontal to BKTF vertical
WKEY	in.	TMINB	Width (thickness) at bottom of key. See note 12

(Continued)





[illegible]

Figure [illegible] illustration of all default values for hydraulic structures (default values are taken from [illegible])

8-9 REINFORCING STEEL. Reinforcing steel data lists are required for module WA only; they are not used in modules FA or FD. They will be generated by module WD so that module WA can be used to spot check stresses after running module WD.

8-9-1 Reinforcement Description. Reinforcement data are stored in the program in arrays ASTLK for the key, ASTLST (location code) for the toe-side face of the stem, ASTLSH (location code, layer number) for the heel-side face of the stem, ASTLBT (location code, layer number) for the top face of the base slab, and ASTLBB (location code, layer number) for the bottom face of the base slab. The location code (called LOC herein) and layer number (called LN, LNA, or LNB) are defined in the sketches following this discussion. Only significant locations along the wall need be defined; the program will fill in the intermediate locations. Significant locations include the outer end of each slab and any intermediate locations where bars are cut off (theoretical cutoff). Detailed instructions follow this summary.

COVR COVHS COVTS COVTB COVBB SPABL

STLB LOC LNA ASTLBT(LOC,LNA) LNB ASTLBB(LOC,LNB)

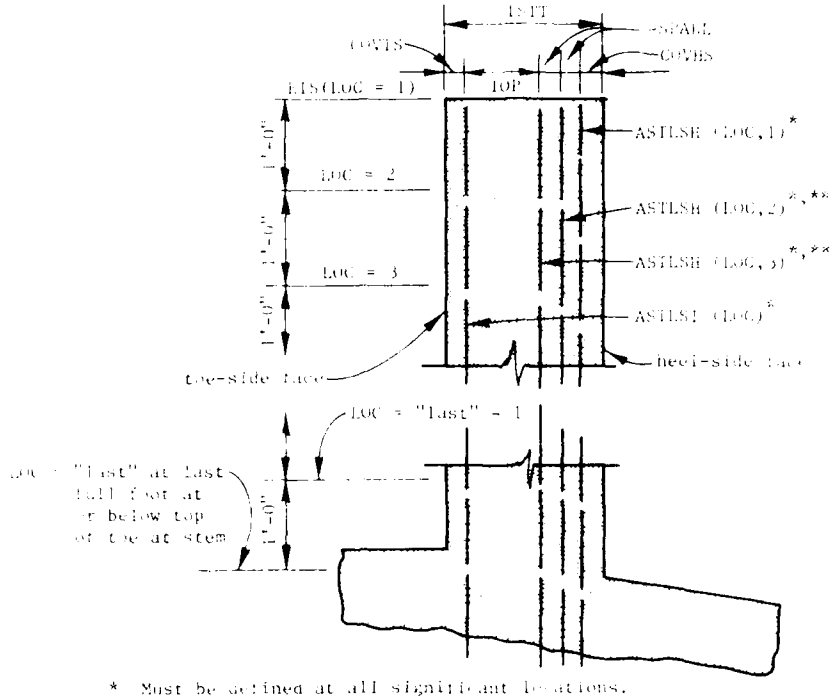
STLK ASTLK (may be omitted if no key)

STLS LOC ASTLST(LOC) LN ASTLSH(LOC,LN)

8-9-2 Bar cover (optional data list COVR) from surface to center of the bar layer closest to the surface (layer number 1); units are inches:

Data Item	Location	Default Values: Hydraulic (IHYD = 1)	Nonhydraulic (IHYD = 2)
COVHS	Heel side of stem	3.5 in.	2.5 in.
COVTS	Toe side of stem	3.5	2.5
COVTB	Top of base slab	3.5	2.5
COVBB	Bottom of base, key	4.5	3.5
SPABL	Spacing between layers, normal to face, center-to-center bars	(MAXBAR's diameter (in data list SIZE) + 1.00 in. If data list SIZE has not been entered, then the default value for SPABL is 2.3 in. for the diameter of a #11 bar + 1 in. clearance	

8-9-3 Stem:



* Must be defined at all significant locations.

** Must be zero at LOC = 1 if reinforcement in this layer does not extend to the end of the member.

Example ASTLSH:

Layer 1 has 0.66 in.^{2}/ft at top of stem, changing to 1.32 in.^{2}/ft 4 ft down.

Layer 2 begins 2 ft down with 0.66 in.^{2}/ft.

No layer 3 used.

Example ASTLST:

0.66 in.^{2}/ft for entire height. Stem is 10 ft high.

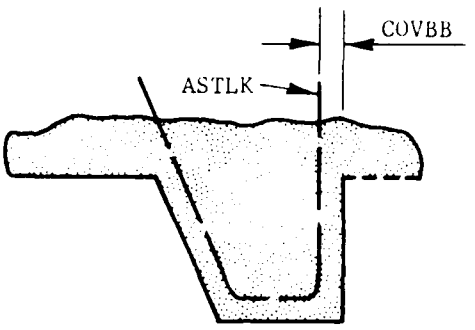
Four data lines will be needed to describe this stem pattern:

SID	LOC	ASTLST(LOC)*	LN	ASTLSH(LOC,LN)	
SID	1	0.66	2	0.66	Note 1
SID	4	0.66	2	0.66	Note 2
SID	5	0.66	2	0.66	Note 3
SID	9	0.66	2	1.32	Note 4

Notes: (1) All layers to be used anywhere in member must be defined (even if zero) at this point at end of member.
(2) LOC = 4 at 4 ft down.
(3) LOC = 5 at 4 ft down.

* LOC = "last" need not be entered.

8-9-4 Key:



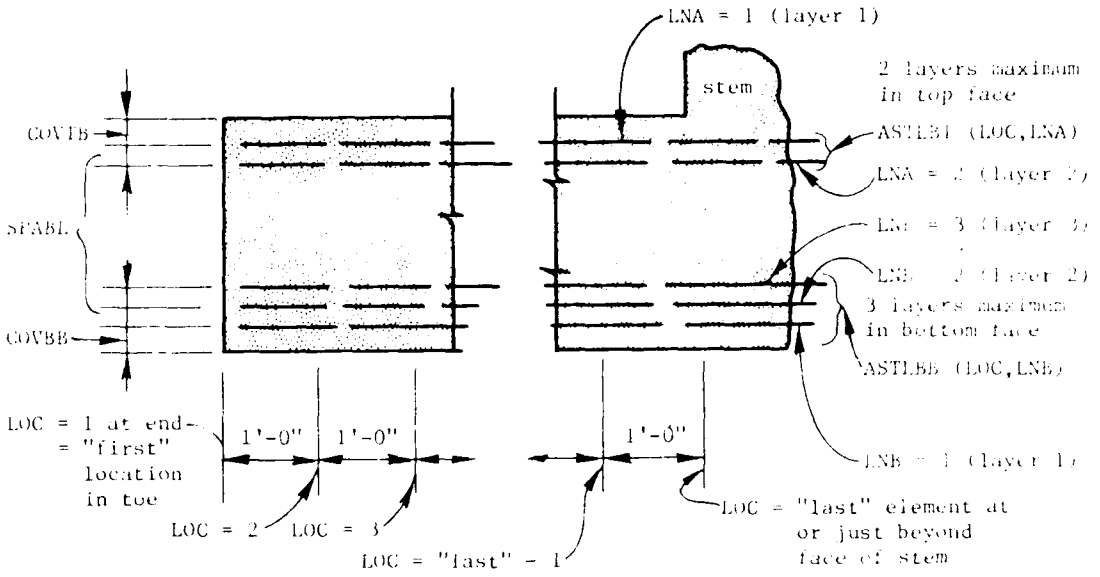
This list may be omitted if DKEY = less than 0.02 ft long or if data lists WLAK and WLDK were not used.

Example for ASTLK = 1.32 $in.^2/ft$:

STLK 1.32

8-9-5 Toe and Heel:

a. Sketch of toe:

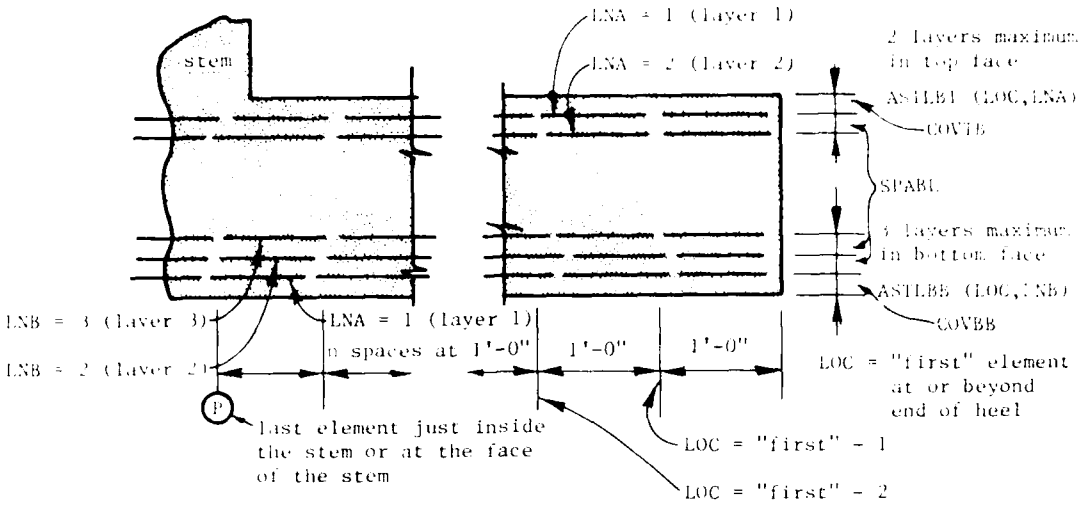


NOTE: Steel definition rules in data list

STLB LOC LNA ASTLBT(LOC,LNA) LNB ASTLBB(LOC,LNB)

are the same as those for a stem with LOC = 1 at the end of the toe.

b. Sketch of heel:



Rules are the same as for stem and toe, except that the "first" element in the heel sketch has the same special rules as element LOC = 1 for the stem and toe. Element P in the heel sketch is the "last" element for heel reinforcement. All this means that the heel reinforcement is entered working inward toward the stem from the end of the heel. The "first" location code LOC is used as being at the lowest numbered whole foot mark, measured from the toe, at or just beyond the end of the heel. The procedure for getting the LOC value for the "first" location code at the end of the heel is:

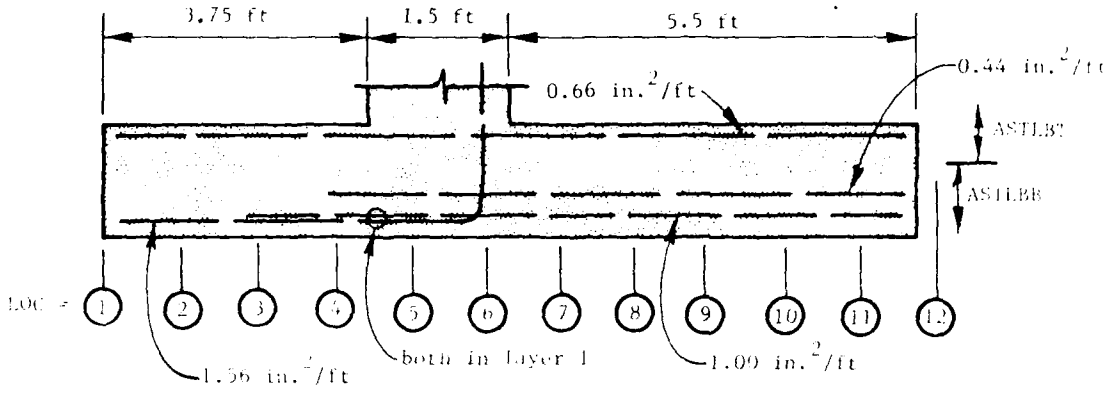
(1) Calculate BW + 1.9999.

(2) Discard (truncate) the decimals.

For example,

BW	BW + 1.9999	LOC at First Element for Heel
15.0	16.9999	16
15.5	17.4999	17

c. Example of base slab reinforcement (toe and heel):



Data List STLB contains LOC,LNA,ASTLBT(LOC,LNA), LNB,ASTLBB(LOC,LNB)

TOE REINF	STLB	1	1	0.66	1	1.56
	STLB	1	1	S	2	0.00
	STLB	3	1	S	1	2.56
	STLB	4	1	S	2	0.44
HEEL REINF	STLB	12	1	0.66	1	1.00
	STLB	12	1	S	2	0.44

8-9-6 Changing Steel Description After a Module Has Been Run:

a. After module WA. Module WA fills in the intermediate location values for the reinforcing steel arrays in data lists STLB and STLS, working from the data entered by the user. It will therefore be necessary to change the intermediate locations, one at a time, as well as the significant locations if the description is to be changed. This can be a lengthy process. A simpler procedure for changing the description in a particular layer is to first enter the letter C for the steel area at location code LOC = 1 in that layer. This will cancel all of the values in that layer. Then, enter the complete (first location and significant locations) new description. For example, to cancel the old toe-side steel in the stem and substitute a new description, do this:

List	LOC	ASTLST(LOC)	LN	ASTLSH(LOC,LN)
Cancel old STLS	1	C	1	S (no change)
Enter new STLS	1	0.44	1	S (no change)
Enter new STLS	5	0.66	1	S (no change)

b. After module WD. The reinforcing steel description produced by this module is listed at the end of the module's report file. The description mav be edited by entering the appropriate data list(s) just as any other data edited. Or, the procedure described in paragraph 8-9-6a can be used.

8-10 CONCRETE ANALYSIS/DESIGN PARAMETERS. Data lists CND and CNWD are used in both module WA and module WD. Data list STLD is used only in module WD. All of these lists are optional. Default values are based on whether the first load case (No. 1 unless data list CNT is used to designate another number as the "first") is hydraulic or nonhydraulic.

CND RATION FPCON ESTL IFEM

CNWD RATIOF FYSTL FSTLMX IBSAME IFDR

STLD MAXBAR SPAMIN

Data List	Variable Name	Units	Default Values		Description
STLD	MAXBAR	ASTM size number	11		Maximum bar size allowed to be used (3-11, 14, or 18 only)
	SPAMIN	in.	MAXBAR's diameter × 2 or MAXBAR's diameter + 2.25, whichever is larger		Minimum allowable clear spacing between bars in same layer. Used with MAXBAR to determine maximum steel allowed in one layer, in square inches per foot
			Hydraulic	Nonhydraulic	
CND	RATION	ratio	(1)	(1)	[illegible]
	FPCON	psi	3,000.0	[illegible]	Concrete ultimate strength
	ESTL	psi	29,000,000.0	29,000,000.0	Reinforcing modulus [illegible]

(Continued)

Data List	Variable Name	Units	Default Values Hydraulic	Default Values Nonhydraulic	Description
CND	IFEM	0 or 1*	1	1	1 to implement the alternate special loadings of paragraph S-21 on page S-23 of EM 1110-2-2501 0 to use loads as described in load case*
CNWD	RATIOF	ratio	0.35**	0.45**	Allowable f_c/f'_c, EM 1110-1-2101
	FYSTL	psi	40,000.0+	40,000.0+	Reinforcing yield strength
	FSTLMX	psi	20,000.0	(2)	Allowable maximum f_s
	IBSAME	0 or 1	(3)	(3)	1 to force the top of heel at stem to the same elevation as the top of toe at the stem 0 to allow them to vary independently

(Continued)

* See paragraph 9-1-2 for more information on IFEM = 1. 1 is Corps of Engineers default; others may prefer 0.

** Set for hydraulic/nonhydraulic status of the "first" load case. The "first" load case is number 1 unless data list CA3 has been used to designate another number as "first."

\+ 20,000.0 is the Corps of Engineers' limit for hydraulic structures; nonhydraulic structures may use the default 50 percent of FYSTL.

Data List	Variable Name	Units	Default Values Hydraulic	Nonhydraulic	Description
	IFDR	0 or 1	1	1	1 to conform to ACI 318-77, Appendix B, para. B.2.3 (in Module WA, report dead and live stresses separately if of opposite sign; in Module WD, use 80 percent of dead load moment if in opposition to live load moment) 0 to use total D+L stress

NOTES: (1) E_c is calculated from the expression in ACI 318-77 code paragraph 8-5-1:

$$E_c = 1(GAMAC - 5.0)^{1.5} \quad 33.0 \sqrt{FPCO}$$

(GAMAC is the weight with reinforcing steel, so 5 pcf is deducted to get to unreinforced concrete.)

(2) FSTEMX is taken at one half of FASTI for nonhydraulic structures.

(3) IBSAME generally defaults to zero but will be used as one for analysis of a level base of constant thickness.

8-11 COST DATA

8-11-1 Use of Cost Data:

a. Cost data are all optional. Default values will be used if not entered (it is not necessary to enter a 0 or 1, but to use the "D" option).

b. The stability analysis modules (WA and WD) calculate the estimated construction cost of the completed wall, in dollar per linear foot, if cost data are entered.

c. The stability design modules (WB and WC) use the construction cost estimated by module WA at the end of optimization.

d. Cost data are illustrated in Figure 8-1.

8-11-2 Data Item Definitions:

List Name	Variable Name	Units	Default Value	Definition
CSTB*				Structural backfill unit costs*
	UCBFFZ	$/ft^3	0.0	Unit cost of filter zone
	UCBFS1	$/ft^3	0.0	Unit cost of soil layer 1
	UCBFS2	$/ft^3	0.0	Unit cost of soil layer 2
	UCBFS6	$/ft^3	0.0	Unit cost of soil layer 6
	UCBFS7	$/ft^3	0.0	Unit cost of soil layer 7
CSTC				Unit costs of reinforced concrete
	UCWB	$/ft^3	1.0	Unit cost of concrete in base slab
	UCWS	$/ft^3	1.0	Unit cost of concrete in stem
	UCWK	$/ft^3	1.0	Unit cost of concrete in key
CSTE*				Unit costs of structural excavation*
	UCEXS3	$/ft^3	0.0	Unit cost of excavation in soil layer 3
	UCEXS4	$/ft^3	0.0	Unit cost of excavation in soil layer 4
	UCEXS5	$/ft^3	0.0	Unit cost of excavation in soil layer 5
	UCEXWK	$/ft^3	0.0	Unit cost of key excavation

* Excavation and backfill volumes are set to zero when data list SSEE is omitted; hence, data lists CSTB and CSTE are immaterial when SSEE is omitted.

CHAPTER 9: SPECIAL NOTES ON MODULES WA AND WD

9-1 AUTOMATIC ALTERNATE LOAD CASES FOR MAXIMUM STRESS

9-1-1 These automatic load cases are controlled by the data variable IFEM in data list CND in paragraph 8-10. Their purpose is to add conservatism to make sure that the uncertainties of data and reaction assumptions do not cause an unsafe design.

9-1-2 These alternate load cases are generated automatically when IFEM = 1, as described in paragraph S-21 of EM 1110-2-2501. They are described below:

a. Stem. Total load case only, no alternates.

b. Toe:

(1) Total load case.

(2) Alternate load case: vertical forces only (to yield more tension in the bottom face reinforcement).

c. Key:

(1) Total load case.

(2) Alternate load case: vertical forces plus horizontal resisting forces only. Driving forces (from beyond heel) are omitted. This is to yield more tension in the toe-side face reinforcement.

d. Heel (applicable only if there is a key at the end of the heel):

(1) Total load case.

(2) First alternate load case: ignore passive pressure, to get more tension in the top face at the stem. This is an approximation of the requirements in paragraph S-21a(1) of EM 1110-2-2501. To get the full implementation, a special load case must be prepared, as described in the User's Reference Manual.

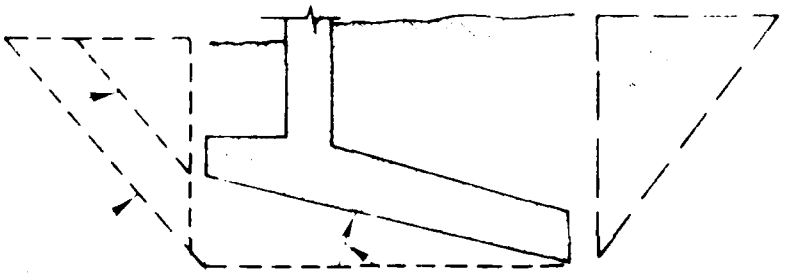
(3) Second alternate load case: ignore all horizontal forces and pressures, to get maximum tension in bottom at stem.

(4) Third alternate load case: ignore driving forces and pressures, to get maximum tension in bottom at the key (if DKEY is at least 0.02 ft long).

(5) Note that paragraph S-21a(3) of EM 1110-2-2501 implies that the top of the heel at the key must not have less reinforcement than is determined for the toe-side face of the key.

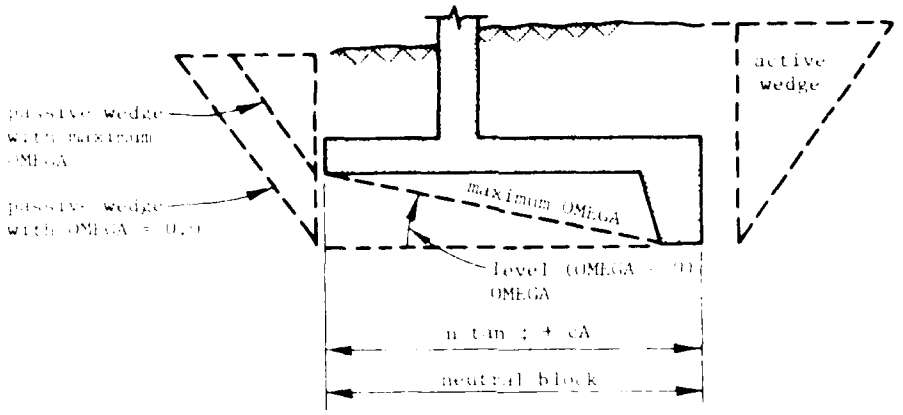
9-2 The combination of IFDR = 1 and IFEM = 1 in module WA can lead to an extensive output. For example, in the toe, each load case

fills five lines to print: total load case dead load, total load case live load, heading for the alternate loading, alternate load case dead load, and alternate load case live load. In the case of the heel, one load case could fill 11 lines (total load case plus three alternates). See paragraph 8-10 for data lists CND (containing the variable IFLM) and CNWD (containing the variable IFDR).

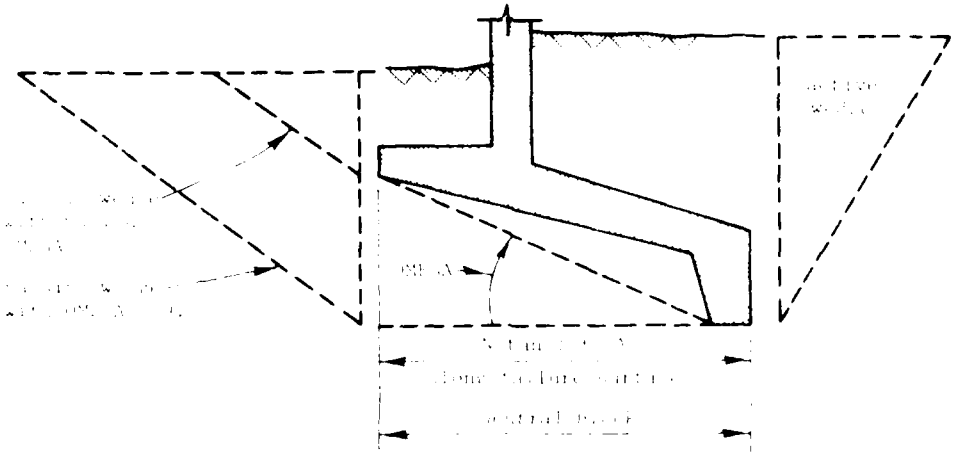


that depends on the value of KFLAG (data list WLAK or WLDK).

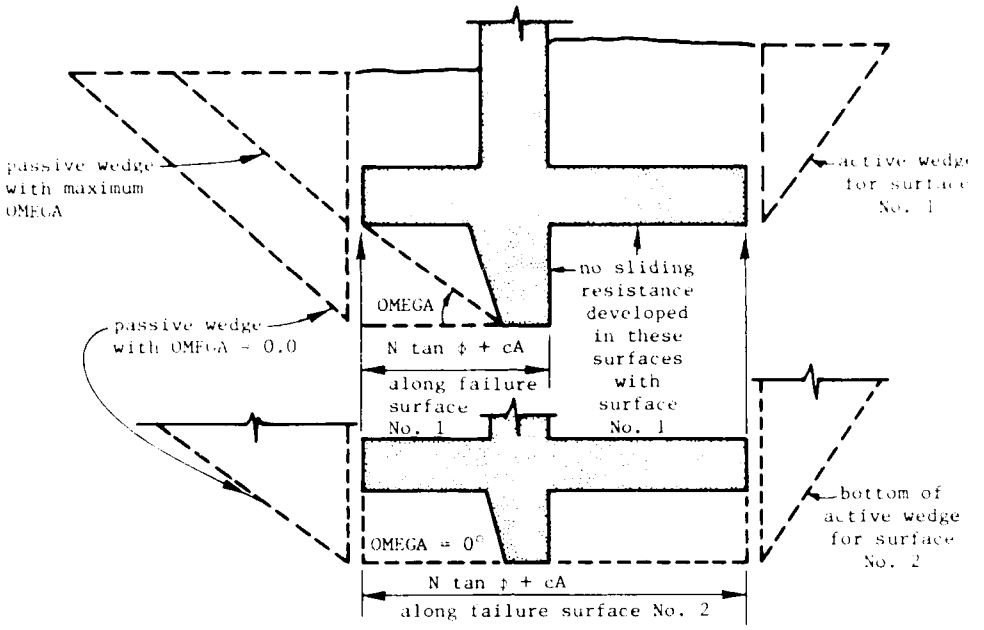
10-6-1 With KFLAG = 0 (key at end of heel), the computation will be as described in LMVD's documentation of the program specifications. The bottom of the neutral block will be like the sketch below for a level base:



And like this for a sloping base:



10-6-2 With KFLAG = 1 (key under stem), the computations will be similar to the KFLAG = 0 situation, but will be based on the descriptions given in LMV2's documentation of the program specifications and diagrammed below. Surfaces 1 and 2 are always both considered:



10-7 All situations with OMEGA greater than zero also include the resisting force of the parallel component of the weight of the neutral block, along the inclined failure surface.

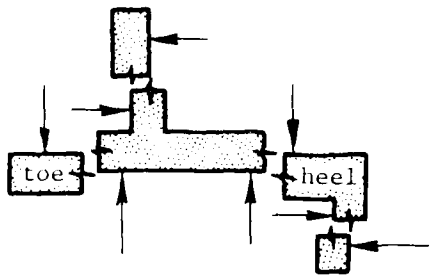
10-8 Uplift calculations for sliding include a line of creep that goes along the bottom of the neutral block and up vertically at each end of the base. Buoyant earth weights are used in the active and passive wedge calculations.

CHAPTER 11: OUTPUT SIGN CONVENTION

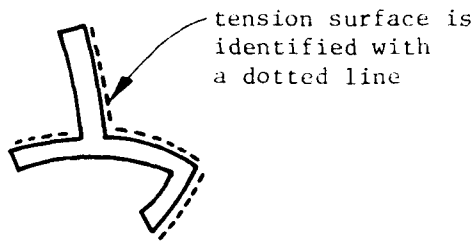
11-1 MODULES WA AND WD

11-1-1 Axial Force. Compression is positive.

11-1-2 Positive Shear:



11-1-3 Positive Moment:



11-2 MODULES FA AND FD. All pressures and forces are positive when they push the wall toward the end of the toe or downward. Thus, passive and bearing pressures are negative. For example, a positive value for RKH in data list SOLP causes inertial forces and an increase in active earth pressure acting to push the wall toward the end of the toe; a positive value for RKV in data list SOLP causes inertial forces acting to move the wall downward. The report file frequently shows absolute values for pressure.

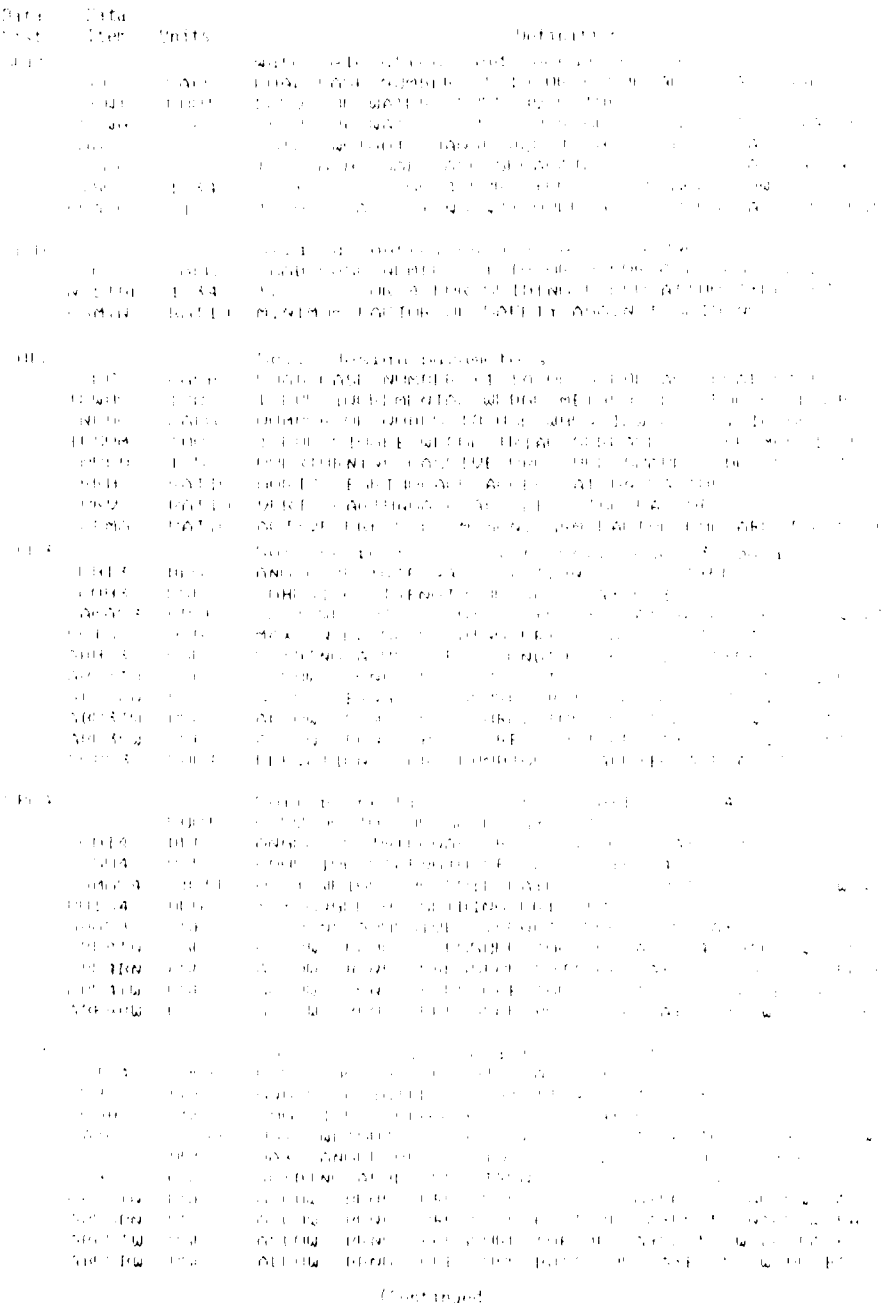
CHAPTER 12: SUMMARY OF DATA LIST CONTENTS

Data List	Data Item	Units	Definition
CNWD			Concrete (Working) Stress Design add'l data
	RATIOF	RATIO	MAX ALLOW CONC STRESS / FPCON (WSD)
	FYSTL	PSI	YIELD STRENGTH OF STEEL REINFORCEMENT
	FSTLMX	PSI	MAX ALLOWABLE WSD REINF STEEL STRESS
	IBSAME	0-1	1 IF HEEL & TOE TOPS FORCED TO SAME ELEV., 0 IF NOT
	IEDR	0-1	1 TO USE ACI 318-77 PAR B.2.3, 0 TO OMIT IT
COVR			Concrete cover to center of reinf. steel
	COVHS	INCH	CONCRETE FACE TO REINF BAR CENTER - HEEL SIDE STEM
	COVTS	INCH	CONCRETE FACE TO REINF BAR CENTER - TOE SIDE STEM
	COVTB	INCH	CONCRETE FACE TO REINF BAR CENTER - TOP OF BASE
	COVBB	INCH	CONCRETE FACE TO REINF BAR CENTER - BOTTOM OF BASE
	SPABL	INCH	CLEAR SPACE BETWEEN REINF BAR LAYERS
CSTB			Unit cost of backfill layers
	UCBFFZ	$/CF	UNIT COST OF BACKFILL - FILTER ZONE
	UCBFS1	$/CF	UNIT COST OF BACKFILL - SOIL LAYER 1
	UCBFS2	$/CF	UNIT COST OF BACKFILL - SOIL LAYER 2
	UCBFS6	$/CF	UNIT COST OF BACKFILL - SOIL LAYER 6
	UCBFS7	$/CF	UNIT COST OF BACKFILL - SOIL LAYER 7
CSTC			Unit cost of reinforced concrete
	UCWB	$/CF	UNIT COST OF CONCRETE - BASE SLAB
	UCWS	$/CF	UNIT COST OF CONCRETE - STEM ABOVE BASE SLAB
	UCWK	$/CF	UNIT COST OF CONCRETE - KEY BELOW BASE SLAB
CSTE			Unit cost of structural excavation
	UCEXS3	$/CF	UNIT COST OF EXCAVATION - SOIL LAYER 3
	UCEXS4	$/CF	UNIT COST OF EXCAVATION - SOIL LAYER 4
	UCEXS5	$/CF	UNIT COST OF EXCAVATION - SOIL LAYER 5
	UCEXWK	$/CF	UNIT COST OF EXCAVATION - KEY BELOW BASE SLAB
HSEH			Horizontal seepage net pressure values
	[illegible]	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CA[illegible]
	[illegible]	EACH	1-11 INTERVALS, PT 1 AT HIGHER WATER EL.
	[illegible]	PSI	NET HORIZONTAL SEEPAGE PRESSURE - STATIC
	[illegible]	PSI	NET HORIZONTAL SEEPAGE PRESSURE - DYNAMIC
[illegible]			Vertical uplift pressure diagram [illegible]
	[illegible]	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR [illegible])
	[illegible]	EACH	1-11 INTERVALS, POINT 1 AT END OF TOE
	[illegible]	PSI	UPLIFT HYDROSTATIC PRESSURE [illegible]
[illegible]			Hydraulic/non-hydraulic [illegible]
	[illegible]	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL [illegible])
	[illegible]	0-1	1 IF HYDRAULIC STRUCTURE, 0 IF NON-HYDR[illegible]
NAME			Job name (60 alphanumeric [illegible])
	JOB	ALPHA	JOB NAME (60 ALPHANUMERIC CHARACTERS MAX)
[illegible]			Single angle for [illegible]
	OMEGA	DEG	SINGLE [illegible] VALUE FOR OMEGA [illegible]
[illegible]			Allowable [illegible]
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD [illegible])
	[illegible]	RATIO	ALLOWABLE OVERSTRESS FACTOR [illegible]

(Continued)

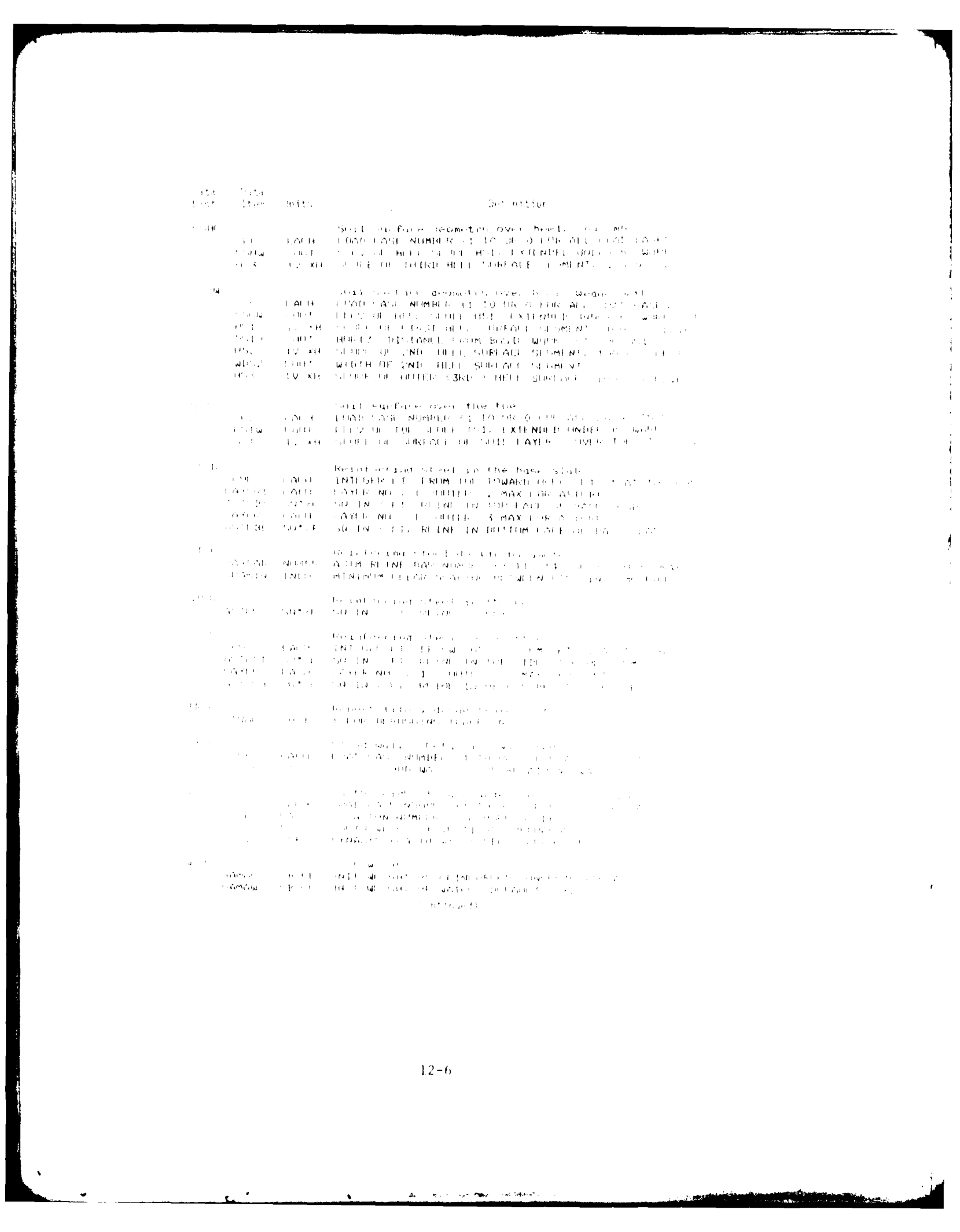
Data List	Data Item	Units	Definition
[illegible]			[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]

(Continued)



Data List	Data Item	Units	Definition
SHL1			Soil properties, heel backfill layer 1
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	PHI1	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 1
	COH1	PSF	COHESIVE STRENGTH OF SOIL LAYER 1
	GAMMA1	PCF	UNIT WEIGHT OF SOIL LAYER 1, SATURATED IF BELOW WT
	KA1	RATIO	ACTIVE EARTH PRESSURE COEFFICIENT FOR SOIL LAYER 1
	DELTA1	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE PRESSURE
	KAE1	RATIO	EARTHQUAKE ACTIVE EARTH PRESSURE COEFFICIENT
	HCMIN	FOOT	MINIMUM HEEL EARTH COVER CHECK VALUE
SHL2			Soil properties, heel backfill layer 2
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ELEV1	FOOT	ELEV OF TOP OF SOIL LAYER 1
	PHI2	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 2
	COH2	PSF	COHESIVE STRENGTH OF SOIL LAYER 2
	GAMMA2	PCF	UNIT WEIGHT OF SOIL LAYER 2, SATURATED IF BELOW WT
	KA2	RATIO	ACTIVE EARTH PRESSURE COEFFICIENT FOR SOIL LAYER 2
	DELTA2	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE PRESSURE
	KAE2	RATIO	EARTHQUAKE ACTIVE EARTH PRESSURE COEFFICIENT
[illegible]			Soil properties, filter zone over heel
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	FZTAU	FOOT	FILTER ZONE THICKNESS AT END OF HEEL
	PHIF	DEG	ANGLE OF INTERNAL FRICTION, FILTER ZONE
	COHF	PSF	COHESIVE STRENGTH OF FILTER ZONE
	GAMMAF	PCF	UNIT WEIGHT OF FILTER ZONE, SATURATED IF BELOW WT
	KAF	RATIO	ACTIVE PRESSURE COEFFICIENT FOR FILTER ZONE
	DELTAF	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE PRESSURE
	KAEF	RATIO	EARTHQUAKE ACTIVE PRESSURE COEFF. FOR FILTER ZONE
[illegible]			Soil properties, toe backfill layer 6
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	PHI6	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 6
	COH6	PSF	COHESIVE STRENGTH OF SOIL LAYER 6
	GAMMA6	PCF	UNIT WEIGHT OF SOIL LAYER 6, SATURATED IF BELOW WT
[illegible]			Soil properties, toe backfill layer 7
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	PHI7	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 7
	COH7	PSF	COHESIVE STRENGTH OF SOIL LAYER 7
	GAMMA7	PCF	UNIT WEIGHT OF SOIL LAYER 7, SATURATED IF BELOW WT
[illegible]			Soil surface, existing grade & Excavation
	EXW	FOOT	EXCAVATION BOTTOM EXTRA WIDTH EACH SIDE OF [illegible]
	[illegible]	1V:xH	EXCAVATION SIDE SLOPE
	[illegible]	1V:xH	EXIST. GROUND SIDE SLOPE BEYOND [illegible] TOE SIDE
	[illegible]	FOOT	EXIST. GRADE, OFFSET FROM ELTOSW (TOE SIDE)
	[illegible]	FOOT	HORIZ. DISTANCE FROM ELTOSW TO [illegible] TOE SIDE
	ELTOSW	FOOT	EXIST. GRADE DIRECTLY UNDER BOTTOM WORKING [illegible]
	[illegible]	FOOT	EXIST. GRADE, OFFSET FROM ELTOSW (HEEL SIDE)
	[illegible]	FOOT	HORIZ. DISTANCE FROM ELTOSW TO [illegible] HEEL SIDE
	[illegible]	1V:xH	EXIST. GROUND SIDE SLOPE BEYOND [illegible] HEEL SIDE

(Continued)



Data List	Data Item	Units	Definition
WIND			Wind loads
	LC	EACH	LOAD CASE NUMBER [illegible]
	W	PSF	WIND PRESSURE ON OTHERWISE UNLOADED STEM AREA
[illegible]			Wall geometry for [illegible]
	[illegible]	FOOT	TOP OF STEM ELEV [illegible]
	TWL	FOOT	HORIZ PROJECTION OF CLEAR WIDTH OF [illegible] FROM [illegible]
	[illegible]	RATIO	STEM RATIO [illegible] WIDTH TWL [illegible] BASE WIDTH BW
	EELW	FOOT	HORIZ PROJECTION OF [illegible] WIDTH OF HEEL FROM [illegible]
[illegible]			Wall geometry for Analysis [illegible]
	BW	FOOT	HORIZ PROJECTION OF BASE WIDTH [illegible]
	BW1	FOOT	MINIMUM VALUE FOR BW (BASE WIDTH) [illegible]
	BW2	FOOT	MAXIMUM VALUE FOR BW (BASE WIDTH) [illegible]
	[illegible]	RATIO	BASE BOTTOM SLOPE [illegible]
[illegible]			Wall geometry for Analysis [illegible]
	HEEL-T	INCH	HEEL THICKNESS AT END (NOT LESS THAN TMINE)
	HEELW	FOOT	HORIZ PROJECTION OF CLEAR WIDTH OF HEEL [illegible]
	HEELTT	INCH	HEEL THICKNESS AT STEM (NOT LESS THAN [illegible])
WLAK			Wall geometry for Analysis [illegible] Key
	KFLAG	0,1	0 IF KEY IS AT HEEL END OF BASE [illegible]
	DKEY	FOOT	KEY VERTICAL LENGTH AT SIDE TOWARD END [illegible]
	WKEY	INCH	KEY WIDTH AT BOTTOM (NOT LESS THAN TMINE)
	[illegible]	RATIO	KEY BATTER OF FACE TOWARD TOE [illegible] DEFAULT
WLAS			Wall geometry for Analysis [illegible]
	TSTT	INCH	STEM THICKNESS AT TOP [illegible]
	TSB	IN/FT	STEM TOE SIDE BATTER IN [illegible]
	TSTB	INCH	HORIZ PROJECTION OF STEM THICKNESS AT BASE
	HSTEM	FEET	STEM HEEL SIDE TOP PANEL HEIGHT
	HSTB	IN/FT	STEM HEEL SIDE TOP PANEL BATTER [illegible]
	BSBOT	IN/FT	STEM HEEL SIDE BOTTOM PANEL BATTER [illegible]
WLAT			Wall geometry for Analysis [illegible]
	[illegible]	FOOT	BOTTOM OF TOE ELEV AT END OF TOE
	[illegible]	INCH	THICKNESS OF TOE AT OUTER END [illegible]
	[illegible]	RATIO	SLOPE OF TOP OF OUTER PANEL [illegible]
	TWI	FOOT	WIDTH OF TOP OF INNER PANEL [illegible]
	[illegible]	[illegible]	SLOPE OF TOP OF INNER PANEL [illegible]
[illegible]			Wall [illegible]
	[illegible]	FOOT	BASE RADIUS FROM BASIC WALL AT [illegible]

(Continued)

Data List	Data Item	Units	Definition
[illegible]			Wall geometry for design modules [illegible]
	[illegible]	FOOT	TOP OF STEM ELEV. (ALL ELEVATIONS MUST BE [illegible])
	[illegible]	FOOT	HORIZ PROJECTION OF CLEAR WIDTH [illegible] FROM [illegible]
	[illegible]	RATIO	STEM RATIO [illegible] WIDTH [illegible] WIDTH [illegible]
	[illegible]	FOOT	HORIZ PROJECTION OF CLEAR WIDTH [illegible] FROM STEM
	[illegible]	INCH	HORIZ PROJECTION OF STEM THICKNESS AT BASE
	[illegible]	INCH	MINIMUM CONCRETE THICKNESS IN BASE SLAB
[illegible]			[illegible]
	[illegible]	[illegible]	MINIMUM VALUE FOR BW [illegible] WIDTH [illegible]
	[illegible]	FOOT	MAXIMUM VALUE FOR BW [illegible] WIDTH [illegible]
	[illegible]	RATIO	MINIMUM VALUE FOR BS [illegible]
	[illegible]	RATIO	MAXIMUM VALUE FOR BS [illegible]
[illegible]			Wall geometry for Design [illegible]
	[illegible]	INCH	HEEL THICKNESS AT END [illegible] NOT LESS THAN TMINB
[illegible]			Wall geometry for Design [illegible]
	[illegible]	[illegible]	[illegible] KEY IS AT HEEL END OF BASE, [illegible] UNDER STEM
	[illegible]	RATIO	BATTER OF [illegible] TOWARD [illegible] [illegible] XV, DEFAULT [illegible]
	[illegible]	FOOT	MINIMUM VALUE OF [illegible] FOR DESIGN (DEFAULT [illegible])
	[illegible]	FOOT	MAXIMUM VALUE OF [illegible] FOR DESIGN [illegible]
[illegible]			Wall geometry for Design [illegible]
	[illegible]	INCH	MINIMUM CONCRETE THICKNESS IN STEM
	[illegible]	RATIO	STEM [illegible] SIDE BATTER, IN [illegible] V (VERTICAL [illegible])
	[illegible]	[illegible]	STEM [illegible] FOR [illegible] PANEL HEIGHT
	[illegible]	[illegible]	STEM [illegible] SIDE [illegible] PANEL BATTER, IN [illegible] V
	[illegible]	INCH	STEM [illegible] SIDE BOTTOM PANEL BATTER, IN [illegible] V
[illegible]			Wall geometry for Design [illegible]
	[illegible]	FOOT	MINIMUM (LOWEST) VALUE FOR [illegible] DESIGN [illegible]
	[illegible]	FOOT	MAXIMUM (HIGHEST) VALUE FOR [illegible] DESIGN
	[illegible]	INCH	[illegible] AT [illegible] END, NOT LESS THAN [illegible]
	[illegible]	FOOT	WIDTH OF TOP OF INNER PANEL OF [illegible] FROM STEM FACE

CHAPTER 13: GRAPHICS DISPLAY OF DATA AND RESULTS

13-1 GENERAL. Module FA has the capability of displaying the input data and computed applied and reactive pressures in graphical form on a Tektronix 4014 graphics display terminal. Output examples are shown later in this Chapter. The program may be run without graphics, on any kind of terminal.

13-2 EQUIPMENT VARIATION EFFECTS. The nongraphics portion of the time-sharing terminal printout from the program does not keep track of how much has been printed on a page. It keeps on printing line after line in typical paper copy fashion. Allowing for this makes the following alternate procedures necessary, depending on which type of Tektronix 4014 terminal is available.

13-2-1 Tektronix 4014 terminal with option 40-41 installed. Use these switch settings:

a. OFF key to setting 1.

b. AUTO PRINT key to the left, for automatic printing of each page.

The screen will automatically be printed, then cleared for the next page as the printout continues with nothing lost. Use the program in the usual way, getting a stack of page copies in the hard copy unit hopper. Answer the question at the end of module FA

```
ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD.)
   OR Ø TO OMIT THE PLOTS
?
```

with a 1. The screen will be erased and execution will proceed as described in paragraph 13-3.

13-2-2 Tektronix 4014 terminal without the 40-41 option installed. Use a regular paper copy printing terminal such as Teletype, Texas Instruments Silent 700, DECWRITER, etc., and answer the question at the end of module FA with a zero. When module FA is complete, either stop the program run with the END command or let the terminal sit waiting for the next command while you move to a Tektronix 4014 terminal. Start the program running on the 4014 and restore (REST command in the program starting sequence) from the UPDATE file from the printing terminal program run. Note that this will not interfere with the program still running on the printing terminal provided that it is waiting for a command. Then RUN module FA, ignoring the printout until the question appears. Answer it with a 1 and proceed to paragraph 13-4. This procedure may be repeated each time the UPDATE file is reset in the run for the printing terminal using the RE command as described above.

13-2-3 No Tektronix 4014 terminal available. Plots are not possible.

13-3 DISPLAY OPTIONS. After the user responds to the first question with a 1, the screen is erased and the following is written:

```
NOTE --- A BELL WILL RING AT SELECTED TIMES
         TO ALLOW YOU TO MAKE A HARDCOPY IF
         YOU SO DESIRE.  TO RESUME EXECUTION
         SIMPLY ENTER A CARRIAGE RETURN

ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      * TO TERMINATE GRAPHICS
?
```

13-4 INPUT DATA. Responding to the above question with a 1 starts the input plotting portion of the code. The user then must enter the number of the load case he wants plotted:

```
ENTER DESIRED ACTIVE LOAD CASE
      OR AN * TO RETURN
?
```

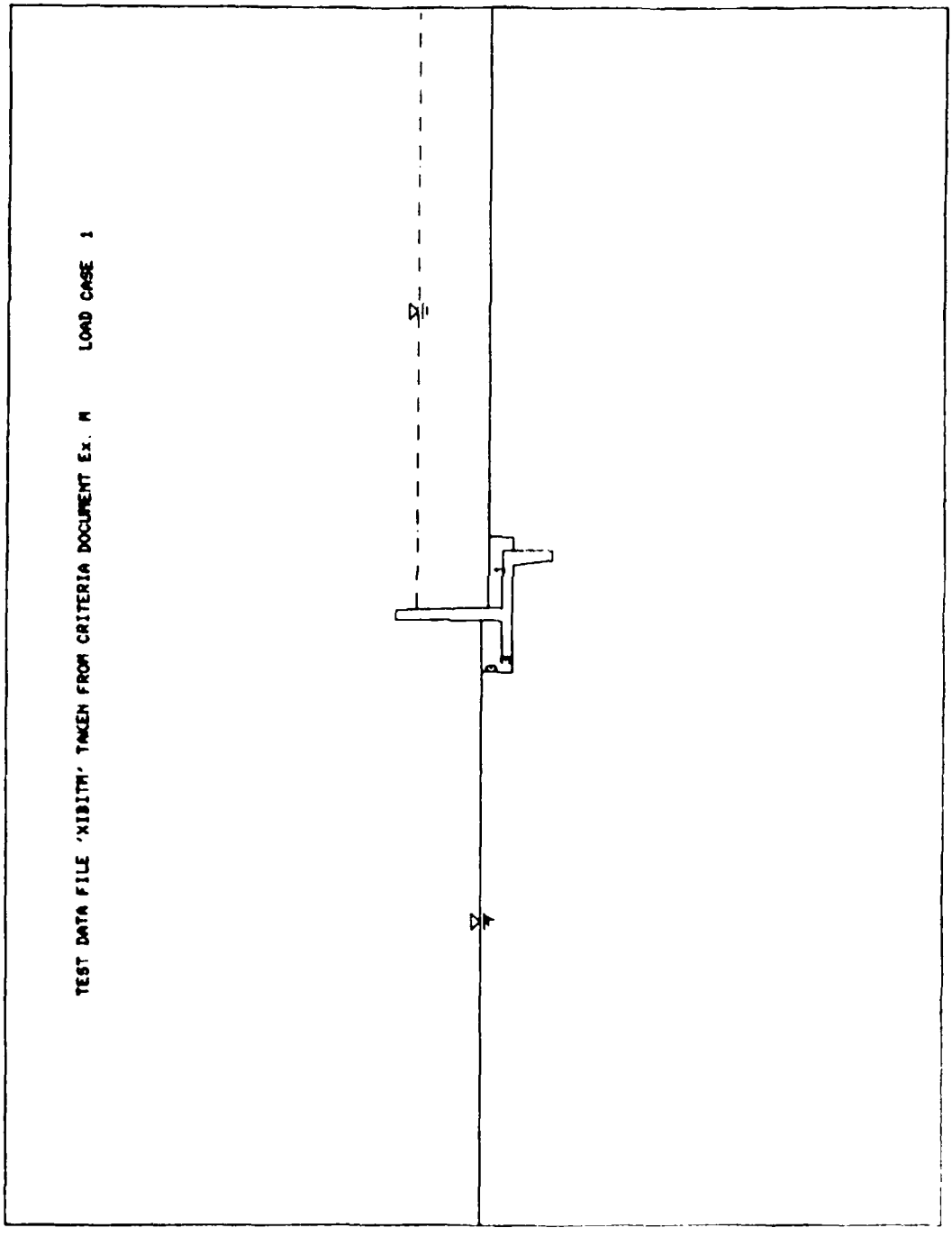
13-4-1 If the user responds with a load case not available, the following message is written:

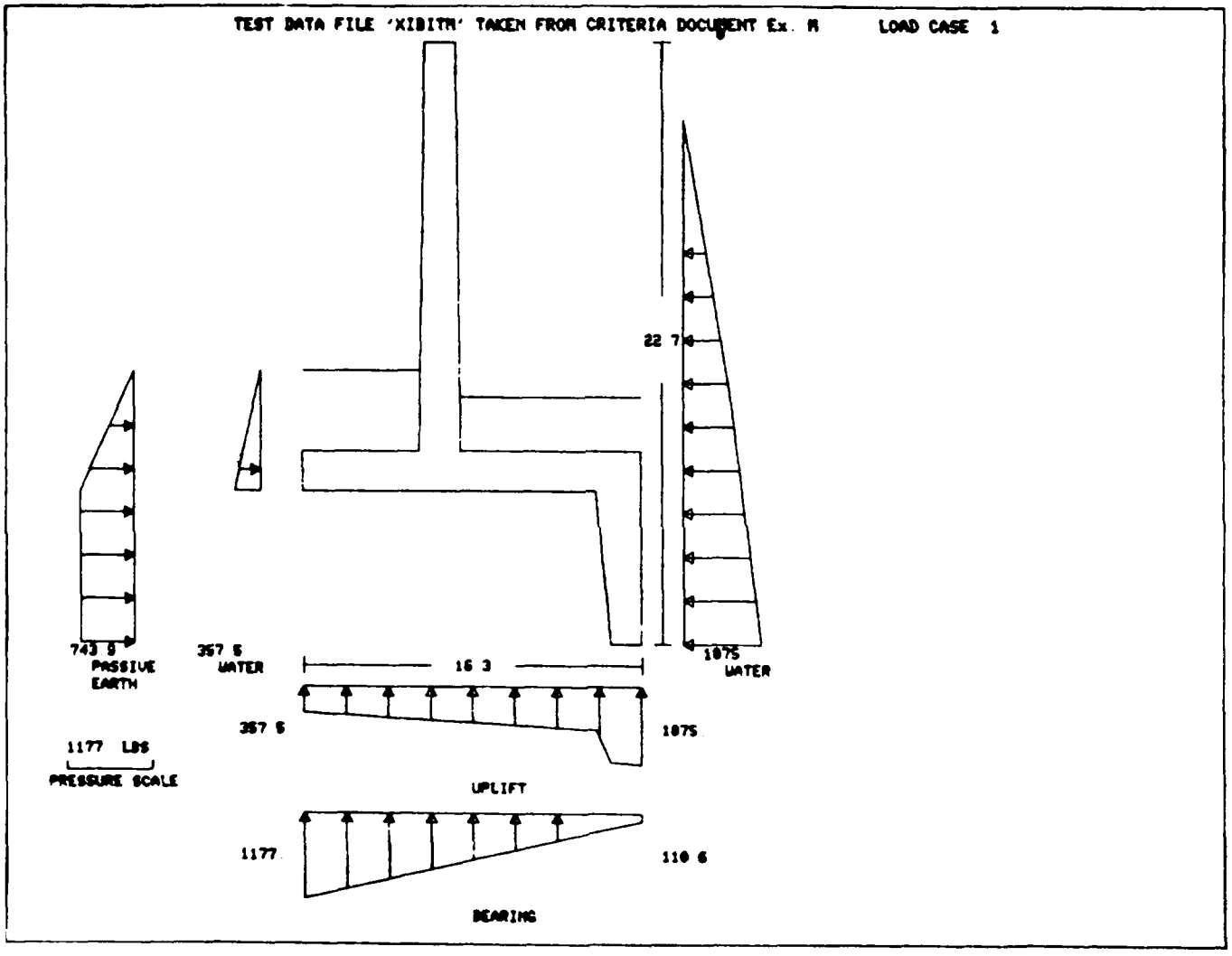
```
   YOUR LOAD CASE SELECTION
   HAS NOT BEEN PROCESSED
   WANT TO TRY AGAIN (Y-OR-N)
?
```

If the user responds with Y, the load case question is repeated. A response of N terminates the graphics portion of TWDA.

13-4-2 If the user responds with a load case number that has been processed, the screen is erased and the following pictures are output:

a. Earth and water data and resulting pressures:

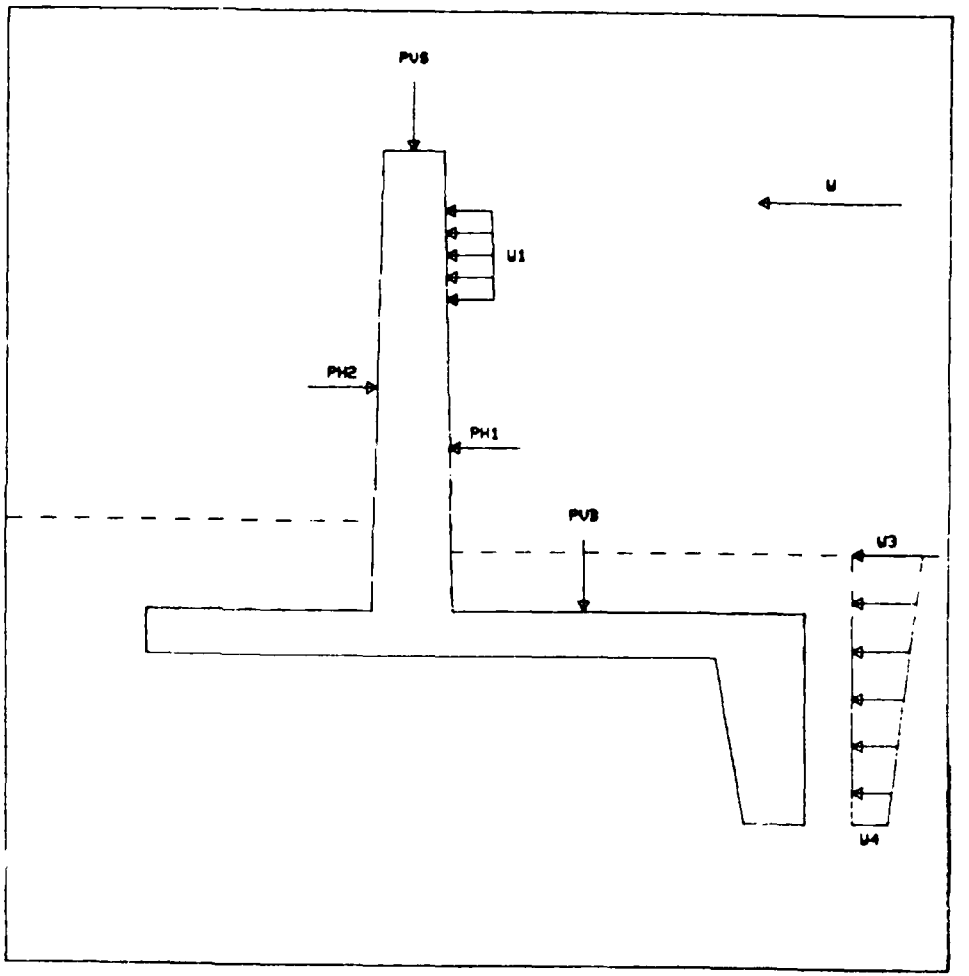



TEST DATA FILE 'XIBITH' TAKEN FROM CRITERIA DOCUMENT Ex. H
LOAD CASE 1
22 7
743 5
PASSIVE
EARTH
357 5
WATER
16 3
1875
WATER
357 5
1875
UPLIFT
1177 LBS
PRESSURE SCALE
1177
110 6
BEARING

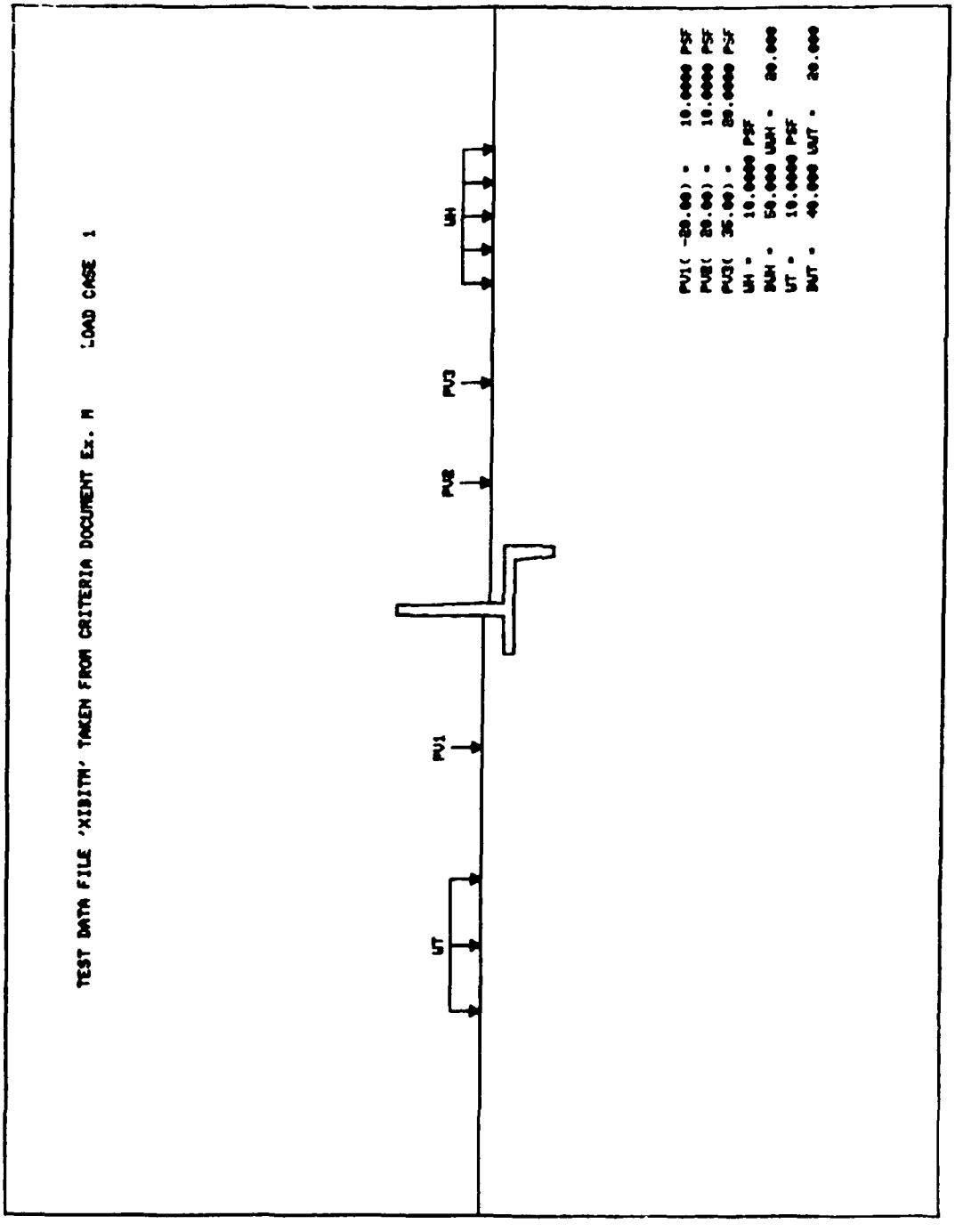
TEST DATA FILE 'XIBITH' TAKEN FROM CRITERIA DOCUMENT Ex. H LOAD CASE 1

LEGEND

PVS(0.75) = 100.0000 PSF
PH1(90.00) = 75.0000 PSF
PH2(92.00) = -75.0000 PSF
PVB(5.00) = 100.0000 PSF
U1 = 50.0000 PSF
ELW1T = 98.0000 FEET
ELW1B = 95.0000 FEET
U3 = 100.0000 PSF
U4 = 50.0000 PSF
U = 40.0000 PSF



b. Surcharges and direct loads. If any loads have been applied to the structure or the top soil layer, the following graphs are output:



13-4-3 The user is then given the opportunity to plot the input for another load case:

```
ENTER 1 TO PLOT ANOTHER LOAD CASE
      Ø TO CONTINUE
?
```

Responding with a Y returns the user to the question in paragraph 13-4. A response of N terminates the input plotting section of the code and returns the user to the question in paragraph 13-3.

13-5 COMPUTED MEMBER FORCES AND MOMENTS

13-5-1 If the user responds with a 2 to the question in paragraph 13-3, the output portion of TWDA is invoked. The available load case numbers are output and the user is then given the opportunity to select a load case to be processed:

```
ACTIVE LOAD CASES
====== ==== =====
                1
ENTER DESIRED ACTIVE LOAD CASE
?
```

If the user selects a load case other than the ones output, the following is output:

```
YOUR LOAD CASE SELECTION HAS NOT BEEN PROCESSED
ENTER AN * TO RETURN OR ANY NUMBER TO TRY AGAIN
?
```

If the user enters an *, the output graphics portion of the code is terminated. If the user enters any number other than $1 \leq n \leq 10$, the following message is output:

```
 YOU HAVE MADE A MISTAKE
 TYPE EITHER 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
?
```

The user then makes another selection.

13-5-2 Once a correct load case has been selected, the user then must choose which member of the wall he wants output displayed for:

TYPE IN MEMBER NUMBER (1-4)

STEM --- 1

TOE --- 2

KEY --- 3

HEEL --- 4

?

If the user responds with any number other than $1 \leq n \leq 4$, the following is output and the user is given another chance to input a member number:

MEMBER SELECTION MUST BE 1, 2, 3, 4

13-5-3 If the user selects a member that is not defined for the particular problem, either the 'KEY' or 'TOE', the following is output:

THE 'TOE' IS NOT DEFINED FOR THIS GEOMETRY

The user is then given the opportunity to select another member or return:

ENTER 1 TO PLOT ANOTHER MEMBER

0 TO CONTINUE

?

A response of '1' returns the user to the question in paragraph 13-5-2. A response of '0' returns the user to the load case selection question (para 13-5-1). Any other response repeats the question. The user must enter either '0' or '1'.

13-5-4 If the selection of a member (paragraph 9) is successful, the screen is erased and the plot selection is displayed to the user:

WHAT PLOT DO YOU DESIRE

TYPE 1 --- AXIAL FORCE

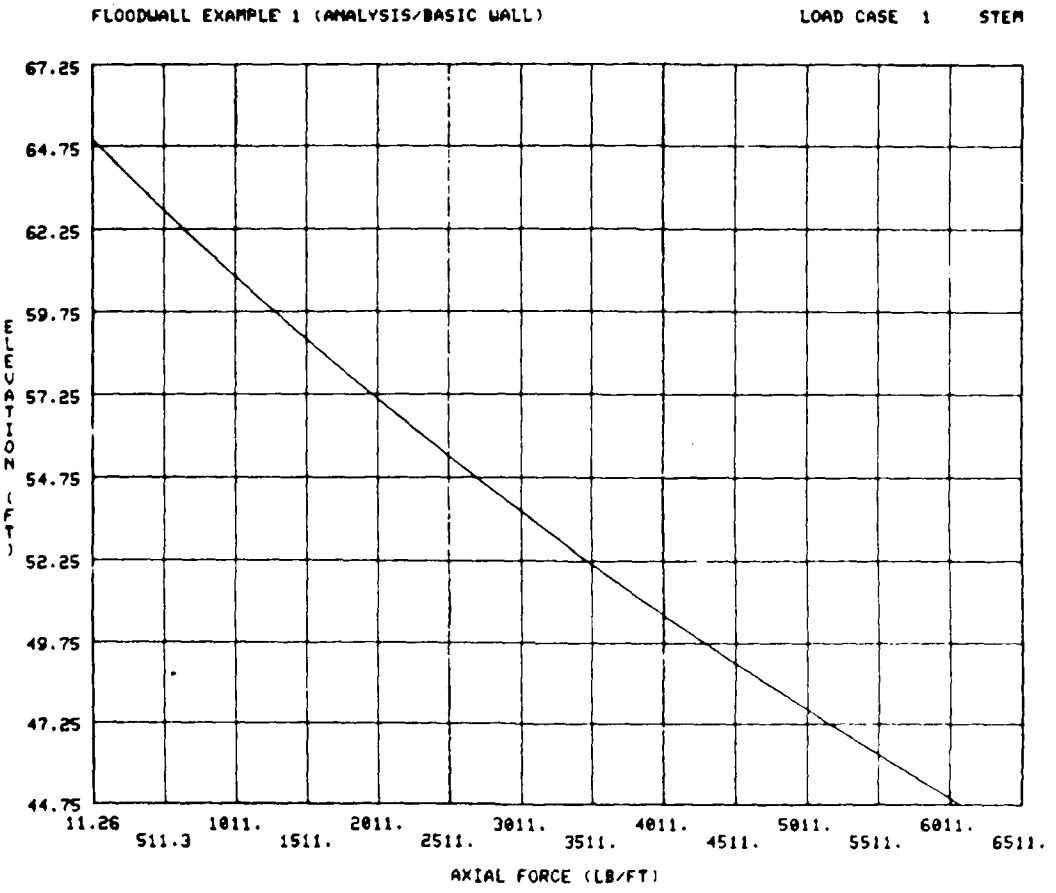
2 --- SHEAR FORCE

3 --- MOMENT

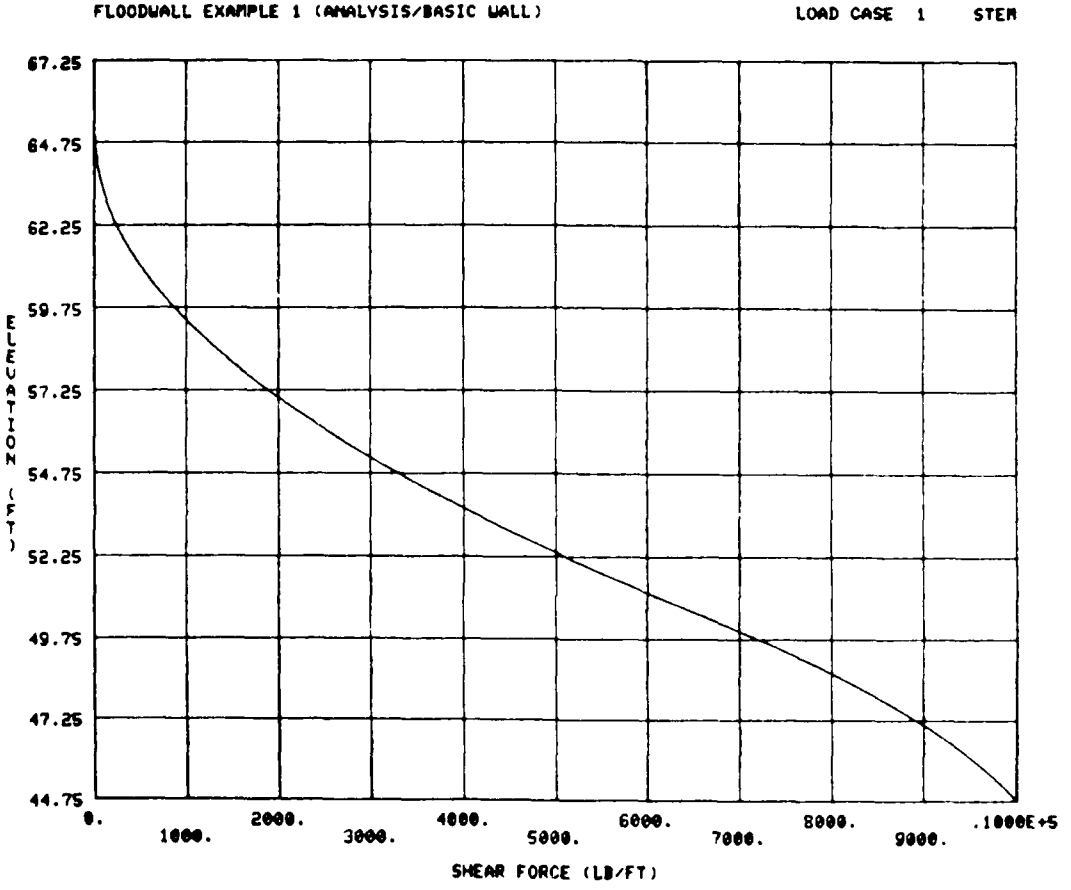
4 --- ALL PLOTS

>4 --- RETURN

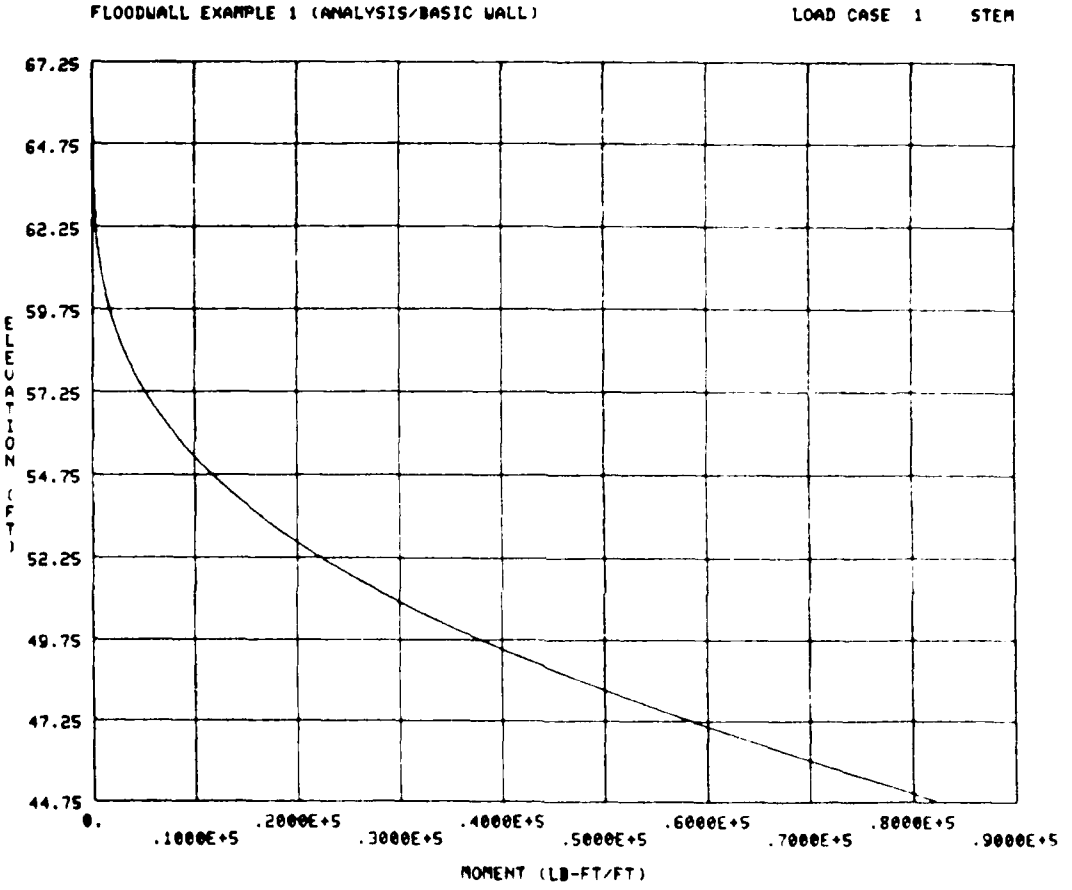
a. A response of 1 gives the user a plot of axial force versus elevation for the member selected. An example of this is as follows:



b. A response of 2 gives the user a plot of shear force versus elevation for the member selected. An example of this plot is below:



c. A response of 3 allows the user to display moment versus elevation for the member selected. An example of this is as follows:



13-5-5 If the user responds with any number greater than 3, the member selection portion of the output graphics routine is again invoked:

```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?
```

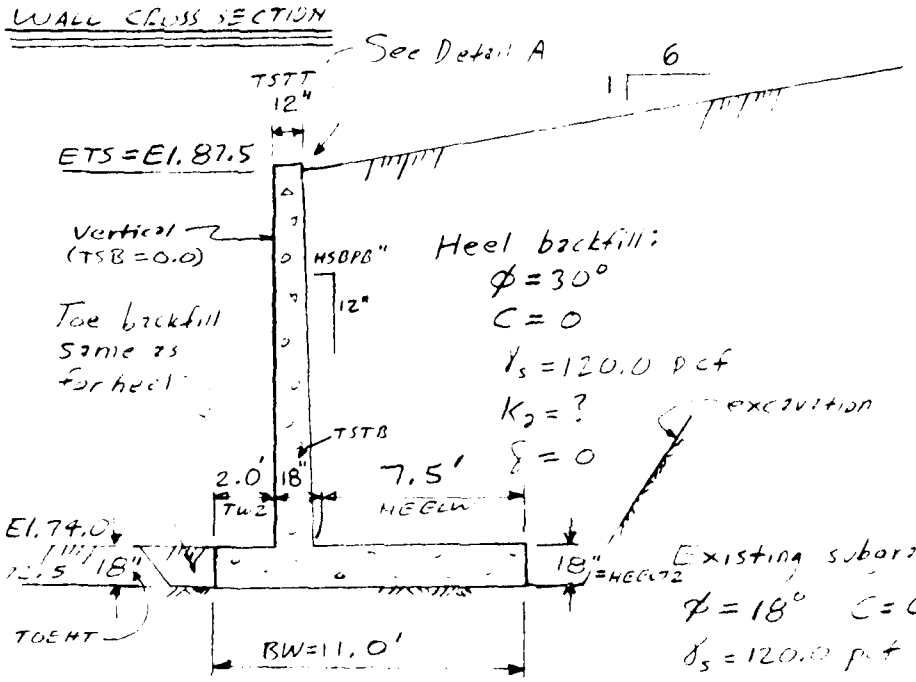
A response of 1 allows the user to select another member for plotting (paragraph 13-5-2). A response of 0 returns the user to the load case level of section.

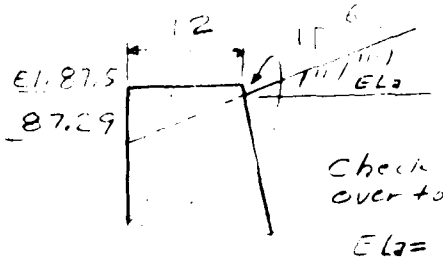
```
ACTIVE LOAD CASES
====== ==== =====
                1
ENTER DESIRED ACTIVE LOAD CASE
      OR AN * TO RETURN
?
```

A response of 1 allows the user to select another load case to be displayed (paragraph 13-5-1). A response of 0 returns the user to input-output selection (paragraph 13-3).

13-6 TERMINATION. Referring to the question in paragraph 13-3, a response of an * terminates the graphics portion of TWDA.

14-1 EXAMPLE 1: ANALYSIS OF A BASIC RETAINING WALL





DETAIL A
not to scale

Check to be sure that earth is not over top of stem:

$$ELa = 87.29 + \frac{12" \div 12"}{6}$$

$$= 87.29 + 0.17$$

$$= 87.46$$

87.46 < 87.50, so o/k

DATA PREPARATION

Starting responses (paragraphs 7.1, 7.2.a)

INIT (because this is a new problem)
1 (how many load cases)
R (for retaining wall)
IV (for non-hydraulic)
NAME EXAMPLE 1 -- BASIC RET WALL ANALYSIS

Selection of data lists needed (see paragraphs 3.2, 8.1 - 8.1.3)

Use Modules FA for foundation analysis and WA for (working) stress analysis, therefore data lists SSHC, SST, SPE3, WLA, WLAB, WLAM, WLAS, WLAT, STLB, and STLS will be needed and the other lists mentioned in paragraph 8.1.3 may be used. A data list is one line of data, consisting of the list name followed by the desired values of the data items in that list. The lists may be entered in any order provided that the values in a list are in the proper order within the list. See also paragraph 5 for list preparation general rules.

Preparation of Data Lists (See paragraphs 8.3-8.12)

Soil Surfaces (data lists beginning with letters "SS"):

★ Over heel (for Coulomb K_a), paragraph 8.3.1.a

Data list name = SSHC
Use Load Case number LC=0 in case additional load cases are added later.

list name	LC	ESHW	HS3
SSHC	0	87.29	6

★ Over Toe, paragraph 8.3.1 b — level grade, at elev. 74.0

list name	LC	ESTW	SST
SST	0	74.0	100.0

★ Existing grade (list SSEE), paragraph 8.3.2

This list is not applicable to analysis, so is omitted.

Soils Properties (data lists beginning with the letters "SP"):

★ Subgrade data list SPE3, paragraph 8.4.1

data list name	Φ PHI3	C psf COH3	γ_s pcf GAMAS3	$\Phi_{sliding}$ ONIS3	sliding adhesion psf ADHS3
SPE3	18	0	120	18	0

Allowable Bearing Pressures, psf				
Top surface BW = BW1 ABP3TN	@ELBS3 BW=BW1 ABP3BN	Top surface BW=BW2 ABP3TW	@ELBS3 BW=BW2 ABP3BW	Elev. of bottom ELBS3
3000	4600	3000	4600	60.00

★ Heel backfill (because Φ, C, or γ_s is different from the subgrade), paragraph 8.4.2 a:

list name	LC	Φ PHI1	C psf COH1	γ_s pcf GAMAS1	K_a RKA1	δ DELTA1	K_{ae} RKAE1	min heel cutoff depth HCMIN
SPH1	0	30	0	120	C	0	C	C

C because it is not applicable

★ Toe backfill (because Φ, C, or γ_s is different from the subgrade), paragraph 8.4.2 b:

list name	LC	Φ PHI7	C, psf COH7	γ_s, pcf GAMAS7
SPT7	0	30	0	120

Soils Foundation Design Parameters (data list SOLP), paragraph 8.5.1:

RKH and RKV are not needed because no earthquake effects are included in the problem.

CFMA is not needed because the default value of 1 is acceptable with no arching active situation.

∴ the list is not needed.

Data list RRD is not applicable to investigation, so is not needed, paragraph 8.5.2

Water - With no water, lists SEEP (para. 8.6.1) and BOIL (para 8.6.2) may be omitted.

Surcharges - With no surcharges, the lists described in paragraph 8.7 may all be omitted.

Cost data are optional for investigation, so may be omitted (paragraph 5.).

Wall Geometry, paragraph 5.8

Use data lists with names beginning with WLA, standing for "Wall Analysis"; Omit list WLAK as being optional when there is no key. See paragraphs 8.8.3 and 8.8.4 for definitions:

	list name	ETS feet	TW2 feet	STR	HEELW feet (can be calculated from data items BW, TW2, TSTB)
*	WLA	87.5	2.0	C	C

	list name	BW feet	BW1 for ABP3$_B^T$N	BW2 for ABP3$_B^T$W	BS 0=level
*	WLAB	11.0	11.0	12.0	0

list name	HEELT2 inches	HEELW feet	HEELT1 inches
* WLAH	18.0	S	18.0

already established in list WLA, so "same"

list name	TSTT inches	TSB in/ft.	TSTB inches	HSTPH feet	HSTPB in/ft	HSBPB in/ft
* WLAS	12.0	0.0	18.0	0.0	0.0	C

no separate top panel

C → already defined by other stem data

list name	BTE1 feet	TOEHT inches	TS2	TW1 feet	TS1
* WLAT	72.5	18.0	100	0.0	100

always use TW1=0 when there is no break in slope on the toe top.

Now see if data list WLDS is needed for 12" TSTT value:

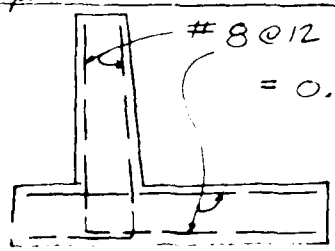
1. ETS − BTE1 = 87.5 − 72.5 = 15.0 feet bkn
2. Paragraph 8.9.2 b (2) says that the default for TMINS is 12 inches for height up to 15 feet, so <u>OK without</u> needing list WLDS.
3. Note: If this list had been needed it would have been entered thus:

list name	TMINS inches	TSB in/ft.	HSTPH feet	HSTPB in/ft	HSBPB in/ft
WLDS	12.0	S	S	S	S

already established in data list WLAS+

(The data are now complete for Module 1=A) -- 3rd Module WA

Reinforcing Steel



* Bar Cover & Spacing, paragraph 8.9.1:
  Default values are all acceptable, so none of these data lists need to be used.

* Stem, paragraph 8.9.2:

list name	LOC	ASTLST(LOC) (1) /1	LN	ASTLSH(LOC, LN) (1) /1
STLS	1	0.79	1	0.79
	(end of stem)			

  Only one use of this list is needed because there is only one layer of steel in the heel-side face and because there are no bar cutoff points.

* Key, paragraph 8.9.3: This list is not needed because there is no key.

* Toe, paragraph 8.9.4 (a):
  Location code LOC = 1 at end of toe. Only one layer of steel in each face, no cutoff points;

list name	LOC	LNA	ASTLBT(LOC, LNA) (11) /1	LNB	ASTLBB(LOC, LNB)
STLB	1	1	0.79	1	0.79

* Heel, paragraph 8.9.4 (b):
  Location code for "first" location at end of base
  = BW + 1.9999, discard decimals
  = 11.5 + 1.999 = 13.4999 → 13

list name	LOC	LNA	ASTLBT(LOC, LNA) (11) /1	LNB	ASTLBB(LOC, LNB) (11) /1
STLB	13	1	0.79	1	0.79

(Note paragraph 8.9.5 a.)

Concrete Analysis Parameters, paragraph 8.10:

The default values are all acceptable, so those lists (CND, CNWD, STLD) are not needed.

Automatic Alternate Load Cases, paragraph 9.1:

"Do not use this" = zero for ITEM in data list CND; may be put in with list

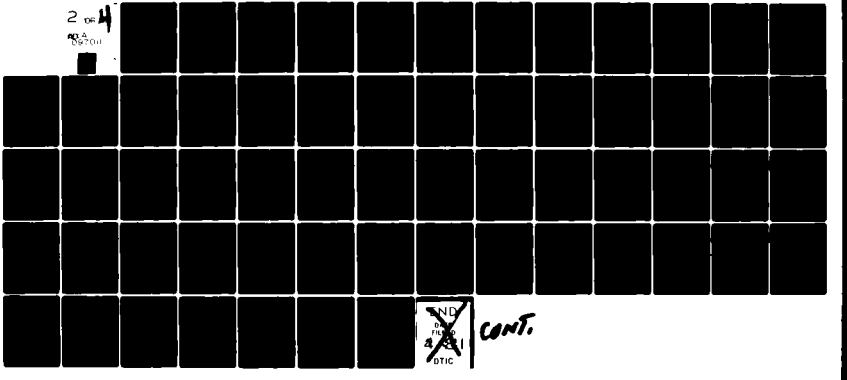
list name	RATION Es/Ec	FPCON f'_c psi	ESTL psi	ITEM 0 or 1
CND	D	D	D	0

or interactively in Module WA -- do this way.

Data Finished -- Put into data file form:

```
1000 INIT
1010 1
1020 R
1030 N
1040 NAME  EXAMPLE 1 -- BASIC RET WALL ANALYSIS
2000 SSMC  0  87.29  6.0
2010 SST   0  74.0   100.0
3000 SPE3  18.0  0.0  120.0  18.0  0.0  3000.0  4600.0
                                  → 3000.0  4600.0  60.0
3010 SPH1  0  30.0  0.0  120.0  C  0.0  C  C
3020 SPT7  0  30.0  0.0  120.0
4000 WLA   87.5  2.0  C  C
4010 WLAB  11.5  11.0  12.0  0.0
4020 WLAH  18.0  S  18.0
4030 WLAS  12.0  0.0  18.0  0.0  0.0  C
4040 WLAT  72.5  18.0  100.0  0.0  100.0
5000 STLS  1  0.79  1  0.79
5010 STLB  1  1  0.79  1  0.79
5020 STLB  13  1  0.79  1  0.79
```

AD-A097 011 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS F/6 13/13
BASIC USER'S GUIDE: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF--ETC(U)
DEC 80 W A PRICE, R L HALL, H W JONES
UNCLASSIFIED WES-INSTRUCTION-K-80-6 NL



CONT.

DATA FILE:

```
 LIST EX1DATA

1000 INIT
1010 1
1020 R
1030 N
1040 NAME  EXAMPLE 1 -  BASIC RETAINING WALL ANALYSIS
2000 SSHC 0  87.29  6.0
2010 SST   0  74.0  100.0
3000 SH13 18.0 0.0 120.0 18.0 0.0 3000.0 4600.0 3000.0 4600.0 60.0
3010 SPH1  0  30.0  0.0  120.0  C  0.0  C  C
3020 SPT7  0  30.0  0.0  120.0
4000 WLA   87.5  2.0  C  C
4010 WLAB  11.0  11.0  12.0  0.0
4020 WLAH  18.0  S  18.0
4030 WLAS  12.0  0.0  18.0  0.0  0.0  C
4040 WLAT  72.5  18.0  100.0  0.0  100.0
5000 STLS  1  0.79  1  0.79
5010 STLB  1  1  0.79  1  0.79
5020 STLB 13  1  0.79  1  0.79
6000 UPDATE
```

TIME-SHARING TERMINAL INPUT AND OUTPUT

```
*RUN WESLIB/TWDA/R

        12/01/80     16.757


PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EX1UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?M.L. WAITES
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?EX1DATA
PROCESSING DATA FILE...

$
$ UPDATE FILE RESET
$


$
$ DATA FILE PROCESSING DONE
$
$ RETURN TO INTERACTIVE INPUT
$

COMMAND
?RUN FA
```

```
THE RESULTANT RATIO =       0.4139, FOR LOAD CASE  1

FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.07, FOR LOAD CASE  1
BY SHEAR FRICTION METHOD


TOTAL CONCRETE VOLUME =          33.38 (CU FT / LF), FOR LOAD CASE  1

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD )
   OR 0 TO OMIT THE PLOTS
?0

!
! UPDATE FILE RESET
!

!
! COMMAND-DATA PHASE ENTERED
!

COMMAND
?RUN WA
!
! BEGIN MODULE WA
!

ENTER 1 TO SEE A TABLE OF X AND Y CORNER COORDINATES
   OR C TO CONTINUE WITHOUT SEEING THE TABLE
?C

TO GET DEFAULT VALUE FOR "ITEM", ANSWER NEXT QUESTION WITH A CARRIAGE RETURN

### ITEM IS NOT DEFINED, SO YOU MUST
    ENTER 0 TO USE LOAD CASES AS-IS
    OR    1 TO ALSO USE EM ALTERNATE SPECIAL LOADINGS
            (A CARRIAGE RETURN WILL INSERT THIS DEFAULT
            VALUE OF 1)
    OR    ? FOR MORE INFORMATION
    OR    C TO CONTINUE DATA CHECK WITHOUT COMPUTATIONS
    OR    * TO ABORT THE MODULE
?0

!
! BEGIN STRESS ANALYSIS
!

ENTER T TO GET THE ANALYSIS RESULTS AT YOUR TERMINAL
   OR R TO PUT THEM IN THE REPORT FILE
   OR B TO PUT THEM BOTH PLACES
?B

ENTER THE LOAD CASE NUMBER YOU WANT ANALYZED
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST "CASE"
   OR * TO STOP THE MODULE
?0

!
! BEGIN STEM STRESS ANALYSIS
!

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *)
?C
```

```
SHEAR AT A DISTANCE d ABOVE THE BASE--

--- SHEAR ANALYSIS AT ELEVATION    75.17  (+ V FROM TOP PUSHED TOWARD TOE) ---
LOAD       V          N (COMP +)        M          UNIT SHEAR    ALLOWABLE   ACI318-77
CASE   LB / SLICE     LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS  PROVISION
----   ----------     ----------   -----------   -----------   -----------  ---------
 1      3643.6         2272.5        14726.         20.267        60.641     B.7.4.5

MOMENT AT THE BASE--

FLEXURE ANALYSIS AT ELEVATION    74.00 (+ M = TENSION AT HEEL)
LOAD   N (COMP=+)        M          FC      FS
CASE   LB / SLICE   LB-FT/SLICE    PSI     PSI
----   ----------   -----------   -----   ------
 1        2531.         19227.      768.   18762.

STEM ANALYSIS COMPLETE TO BASE

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
?N

#
# BEGIN TOE STRESS ANALYSIS
#

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *):
?C


SHEAR AT A DISTANCE d FROM THE STEM--
---) ANALYSIS WITHIN 1-FOOT OF END OF TOE IS MEANINGLESS (---


MOMENT AT THE STEM (POINT 2)--

FLEXURE ANALYSIS AT X = -0.001 ( 1.999 FROM END OF TOE) (+ M = TENSION IN TOP)
LOAD   N (COMP=+)        M          FC      FS
CASE   LB / SLICE   LB-FT/SLICE    PSI     PSI
----   ----------   -----------   -----   ------
 1           8.         -4344.      180.    4959.

TOE ANALYSIS COMPLETE TO STEM

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *):
?N

#
# BEGIN HEEL STRESS ANALYSIS
#

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
?C


SHEAR AND MOMENT AT THE STEM--

--- SHEAR ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+V = END DOWN) ---
LOAD       V          N (COMP +)        M          UNIT SHEAR    ALLOWABLE   ACI318-77
CASE   LB / SLICE     LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS  PROVISION
----   ----------     ----------   -----------   -----------   -----------  ---------
 1      3940.7         1218.0        20848.         21.187        60.453     B.7.4.5

FLEXURE ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD   N (COMP=+)        M          FC      FS
CASE   LB / SLICE   LB-FT/SLICE    PSI     PSI
----   ----------   -----------   -----   ------
 1        1218.         20848.      802.   21394.
```

```
HEEL ANALYSIS COMPLETE TO END

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
?S

BEGIN ANALYSIS AT SELECTED SECTIONS
END OF HEEL IS AT X =   9.000, STEM FACE AT   1.500
TOP OF KEY FACE TOWARD STEM IS AT X =   9.000

ENTER THE X-COORDINATE (DIST FROM BASIC WORK POINT)
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
   OR N, R, OR * FROM TYPE SELECTION
?2.0


SHEAR AND MOMENT AT X =   2.000



--- SHEAR ANALYSIS AT X =  2.000 ( 7.000 FROM END OF HEEL) (+V = END DOWN) ---
LOAD      V          N (COMP +)        M          UNIT SHEAR   ALLOWABLE  ACI318-77
CASE  LB / SLICE    LB / SLICE  LB-FT/SLICE  STRESS  PSI  UNIT STRESS PROVISION
----  ----------    ----------  ------------  ----------  ----------- ----------
 1      3984.2        1218.0        18869.        21.421       60.453     B7.4.5

FLEXURE ANALYSIS AT X =  2.000 ( 7.000 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD  N (COMP=+)        M          FC      FS
CASE  LB / SLICE  LB-FT/SLICE    PSI     PSI
----  ----------  ------------  -----  ------
 1        1218.         18869.    728.  19284.

ENTER THE X-COORDINATE (DIST FROM BASIC WORK POINT)
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
   OR N, R, OR * FROM TYPE SELECTION
?N

#
# MODULE WA COMPLETE
#

#
# UPDATE FILE RESET
#


#
# COMMAND-DATA PHASE ENTERED
#

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
?RO

SNUMB # 8201A


your update file for future restart is named EX1UPD
stop    OK (release unneeded files)

*
```

REPORT FILE (PRINTED AT COPE TERMINAL)

```
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
          16:48:38 ON 12/ 1/80


 NOTES TO EXPLAIN SPECIAL PRINTOUT THAT MIGHT BE IN THIS FILE**

 THE VALUE "*.1234E+31" IS USED TO DENOTE AN  UNDEFINED ITEM;
 THE VALUE "*.1432E+31" MEANS THAT THE DEFAULT VALUE WAS REQUESTED.

 A "MEMORY FAULT AT ..." MESSAGE PROBABLY MEANS THAT NEEDED DATA IS UNDEFINED.

.

 END OF NOTES.

 COMMAND ENTERED:
 INIT

 #* ALL DATA RESET FOR FRESH START *#

 COMMAND ENTERED:
 R

 COMMAND ENTERED:
 N
```

```
          16:49: 7 ON 12/ 1/80

WALL DECLARED TO BE A NON-HYDRAULIC RETAINING WALL


COMMAND ENTERED:
NAME  EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS

COMMAND ENTERED:
SSHC 0  87.29  6.0

COMMAND ENTERED:
SST   0  74.0  100.0

COMMAND ENTERED:
SPE3 18.0 0.0 120.0 18.0 0.0 3000.0 4600.0 3000.0 4600.0 60.0

COMMAND ENTERED:
SPH1  0  30.0  0.0  120.0  C  0.0  C  C

COMMAND ENTERED:
SPT7  0  30.0  0.0  120.0

COMMAND ENTERED:
WLA   87.5  2.0  C  C

COMMAND ENTERED:
WL4H  11.0  11.0  12.0  0.0

COMMAND ENTERED:
WL4H  18.0  S  18.0

COMMAND ENTERED:
WLAS  12.0  0.0  18.0  0.0  0.0  C

COMMAND ENTERED:
WLAT  72.5  18.0  100.0  0.0  100.0

COMMAND ENTERED:
STLS  1  0.79  1  0.79

COMMAND ENTERED:
STLB  1  1  0.79  1  0.79

COMMAND ENTERED:
STLB 13  1  0.79  1  0.79

COMMAND ENTERED:
UPDATE

#
# UPDATE FILE RESET
#


COMMAND ENTERED:


COMMAND ENTERED:
RUN FA
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         16:55: 1 ON 12/ 1/80


#
# BEGIN BASIC STABILITY DATA CHECK
#
DEFAULT VALUE OF     62.50000      USED FOR GAMAW       (LOAD CASE  1)
DEFAULT VALUE OF     150.0000      USED FOR GAMAC       (LOAD CASE  1)
DEFAULT VALUE OF     1.000000      USED FOR FSS         (LOAD CASE  1)
DEFAULT VALUE OF     2.000000      USED FOR EXW         (LOAD CASE  1)
DEFAULT VALUE OF    0.             USED FOR UCEX83      (LOAD CASE  1)
DEFAULT VALUE OF    0.             USED FOR UCEX84      (LOAD CASE  1)
DEFAULT VALUE OF    0.             USED FOR UCEX85      (LOAD CASE  1)
DEFAULT VALUE OF    0.             USED FOR UCBF81      (LOAD CASE  1)
DEFAULT VALUE OF    0.             USED FOR UCBF82      (LOAD CASE  1)
DEFAULT VALUE OF    0.             USED FOR UCBFF2      (LOAD CASE  1)
DEFAULT VALUE OF    0.             USED FOR UCBF87      (LOAD CASE  1)
DEFAULT VALUE OF    0.             USED FOR UCBF86      (LOAD CASE  1)
DEFAULT VALUE OF     1.000000      USED FOR UCWS        (LOAD CASE  1)
DEFAULT VALUE OF     1.000000      USED FOR UCWB        (LOAD CASE  1)
DEFAULT VALUE OF     1.000000      USED FOR UCWK        (LOAD CASE  1)
DEFAULT VALUE OF           2       USED FOR IFWOC       (LOAD CASE  1)
DEFAULT VALUE OF           1       USED FOR IFSOM       (LOAD CASE  1)
DEFAULT VALUE OF     1.000000      USED FOR CFMA        (LOAD CASE  1)
DEFAULT VALUE OF    0.3333333      USED FOR RRMIN       (LOAD CASE  1)
DEFAULT VALUE OF           2       USED FOR KRACK       (LOAD CASE  1)
DEFAULT VALUE OF     2.000000      USED FOR FSMIN       (LOAD CASE  1)
DEFAULT VALUE OF           1       USED FOR NSLIDE      (LOAD CASE  1)
DEFAULT VALUE OF    0.             USED FOR HGSW        (LOAD CASE  1)
DEFAULT VALUE OF     100.0000      USED FOR HSSSW       (LOAD CASE  1)
DEFAULT VALUE OF    0.             USED FOR DTSSW       (LOAD CASE  1)

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         16:55: 2 ON 12/ 1/80


#
# BEGIN PART 2 OF STABILITY DATA CHECK
#
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         16:55: 2 ON 12/ 1/80


#
# BEGIN MODULE FA
#

VARIABLE HEELW CALCULATED        7.50 (BW-TW2-TSTR)
VARIABLE HSRPB CALCULATED OR DEFAULTED TO CLOSE COORDINATES,
         HSRPB =  0.000000 IN/FT.
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	87.5000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.	74.0000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0.	74.0000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-2.0000	74.0000	TOP OF TOEWT = AT OUTER END OF TW2
5	-2.0000	72.5000	TOE END OF BASE = AT RTE1
10	9.0000	72.5000	HEEL END OF BASE
11	9.0000	74.0000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.5000	74.0000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.0000	87.5000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.0000	87.5000	TOP OF HEEL-SIDE FACE OF STEM

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
16:55: 5 ON 12/ 1/80

#
BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:

BACKFILL LAYER	KA VALUE
1	0.3711

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 1
FOR CLASSIC(COULOMB) ANALYSIS IN SA (END OF HEEL)

OUTPUT OF ARRAYS H, EH, AND YH IN MODULE SA FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
88.790	7.4212	0.
87.790	44.527	0.
86.790	89.055	0.
85.790	133.58	0.
84.790	178.11	0.
83.790	222.64	0.
82.790	267.16	0.
81.790	311.69	0.
80.790	356.22	0.
79.790	400.75	0.
78.790	445.27	0.
77.790	489.80	0.
76.790	534.33	0.
75.790	578.85	0.
74.790	623.38	0.
73.790	667.91	0.
72.790	452.72	0.
72.500	104.55	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 5907.97 LBS/HORIZ FT
ACTING AT ELEVATION 77.93

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE w3-w4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 1

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	5006.25	0.	20278.13
ACTIVE EARTH	0.	5907.97	-32080.30
SOIL+WATER	13151.94	0.	94469.53
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	18158.19	5907.97	82667.35

```
 EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
          16:55:  4 ON 12/ 1/80


*
* BEGIN THE OVERTURNING COMPUTATION
*




      LOAD CASE    1



 DEFAULT VALUE OF            1        USED FOR TSFT(LC)    (LOAD CASE  1)

 DEFAULT VALUE OF            3        USED FOR NPPD(LC)    (LOAD CASE  1)

RESULTANT IS WITHIN THE KERN

CREEP PATH DESCRIPTION FOR LOAD CASE 1

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
     9.00               72.50                    0.
     9.00               72.50                    0.
    -2.00               72.50                    0.
    -2.00               72.50                    0.

 OVERTURNING HYDRAULIC GRADIENT  =  0.


 > VALUE OF NPPD(LC)    FOUND =           3       IN S/R CHEKIT (LOAD CASE  1)

 > VALUE OF ADHS3       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  1)

 > VALUE OF PHIS3       FOUND =    18.00000       IN S/R CHEKRT (LOAD CASE  1)

 > VALUE OF ADHS4       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  1)

 > VALUE OF ADHS5       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  1)

 > VALUE OF PHIS4       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  1)

 > VALUE OF PHIS5       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  1)
```

```
AT BASE-SOIL INTERFACE:
  WEIGHTED AVERAGE COEFFICIENT OF FRICTION =        0.32
  WEIGHTED AVERAGE ADHESION                =        0.    (LBS/SQ.FT)
  EFFECTIVE BASE WIDTH                     =       11.00  (FEET)
  EFFECTIVE LENGTH ALONG BASE SLOPE        =       11.00  (FEET)
  NORMAL FORCE ACTING ON BASE              =    18158.19  (LBS/SLICE)
  FRICTIONAL FORCE                         =     5899.95  (LBS/SLICE)
  FORCE DUE TO ADHESION                    =        0.    (LBS/SLICE)
  TOTAL FORCE ALONG BASE                   =     5899.95  (LBS/SLICE)
  HORIZONTAL COMPONENT OF TOTAL FORCE      =     5899.95  (LBS/SLICE)


PASSIVE EARTH PRESSURES FOR LOAD CASE  1

NPPD                                =          3
ELEVATION OF TOP OF SOIL            =    74.020      (FT)
PRESSURE AT TOP OF SOIL             =  0.            (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL   =    72.500      (FT)
PRESSURE AT LOWEST POINT ON WALL    =  -10.553       (LBS/SQ.FT)
PASSIVE EARTH FORCE                 =   -8.0201      (LBS/SLICE)
PASSIVE EARTH MOMENT                =    4.0635      (FT-LBS/SLICE)


DISTANCE FROM THE TOE TO THE RESULTANT        =  4.55 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE =        0.    (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES =        0.    (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES =       0.    (FT-LBS/SLICE)


THE RESULTANT RATIO =      0.4139, FOR LOAD CASE  1
```

```
 EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
          16:55: 4 ON 12/ 1/80


#
# BEGIN SLIDING COMPUTATION
#


 FINAL FACTOR OF SAFETY AGAINST SLIDING =     1.07, FOR LOAD CASE  1
 BY SHEAR FRICTION METHOD

      SUM OF DRIVING FORCES  =  5907.973 (LBS/SLICE)
      SUM OF RESISTING FORCES =  6304.766 (LBS/SLICE)

      PASSIVE EARTH FORCE                    =    404.81 (LBS/SLICE)
      ACTIVE EARTH FORCE                     =   5907.97 (LBS/SLICE)
      UPLIFT FORCE                           =      0.   (LBS/SLICE)
      SUMMATION OF HORIZONTAL WATER FORCES =      0.   (LBS/SLICE)

       FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
           X          Y
         -2.00      72.50
          9.00      72.50




 EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
          16:55: 5 ON 12/ 1/80


#
#  BEGIN ALLOWABLE BEARING CAPACITY COMPUTATIONS
#


THE BASE LIES IN SOIL 3


 FOR LOAD CASE  1,

 FOR THE BASE COORDINATES  X= -2.00  Y= 72.50, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =   3867.13 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE         =   2503.57 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X=  9.00  Y= 72.50, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =   3867.13 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE         =    797.92 (LBS/SQ.FT)

 THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE,  1
```

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
16:55: 5 ON 12/ 1/80

#
BEGIN COST ANALYSIS
#

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	0.	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	0.	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	16.88	1.00	16.88
BASE	16.50	1.00	16.50
KEY	0.	1.00	0.

TOTAL CONCRETE VOLUME = 33.38 (CU FT / LF), FOR LOAD CASE 1

#
BEGIN SOIL CONTROL CALCULATIONS FOR LOAD CASE 1
#

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF 72.50 IS 0.

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         16:55: 7 ON 12/ 1/80



#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#



  COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
     BACKFILL LAYER          KA VALUE
     --------------          --------
           1                 0.3879

          HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  1
          FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)


          OUTPUT OF ARRAYS HS, EHS, AND YYS IN MODULE SP FOR CLASSIC ANALYSIS,

            ELEVATION   INCREMENTAL HORIZONTAL   INCREMENTAL HORIZONTAL
                          STATIC FORCE             EARTHQUAKE FORCE
               (FT)          (LBS/FT)                 (LBS/FT)
            ---------   ------------------------   ---------------------
            87.457              7.7689                    0.
            86.457             46.614                     0.
            85.457             93.227                     0.
            84.457            139.84                      0.
            83.457            186.45                      0.
            82.457            233.07                      0.
            81.457            279.68                      0.
            80.457            326.30                      0.
            79.457            372.91                      0.
            78.457            419.52                      0.
            77.457            466.14                      0.
            76.457            512.75                      0.
            75.457            559.36                      0.
            74.457            435.19                      0.
            74.000            141.59                      0.

          FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

          RESULTANT HORIZONTAL STATIC ACTIVE FORCE =    4220.41 LBS/HORIZ FT
          ACTING AT ELEVATION    78.49

          RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
          DUE TO EARTHQUAKE =       0.   LBS/HORIZ FT
          ACTING AT ELEVATION     0.


#
# EXIT MODULE FA
#


 #
 # UPDATE FILE RESET
 #

 COMMAND ENTERED:
 RUN WA
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         16:55:53 ON 12/ 1/80

#
# BEGIN MODULE WA
#

DEFAULT VALUE OF    0.              USED FOR BASER       (LOAD CASE  1)

DEFAULT VALUE OF             0      USED FOR KFLAG       (LOAD CASE  1)

DEFAULT VALUE OF    0.              USED FOR DKEY        (LOAD CASE  1)

HEELW  CALCULATED TO BE      7.5000

STR    CALCULATED TO BE     0.18182

YOUR HEELT1 VALUE OF    18.00      INCHES SET THE TOP
OF THE HEEL AT THE STEM (    74.0000) SO CLOSE TO THE TOP
OF THE TOE AT THE STEM THAT BOTH WERE SET TO THE SAME VALUE
OF     74.0000 FEET.

SLOPE OF TOP OF HEEL SLAB = 100.00 H : 1 V (100.01 = LEVEL)


                COORDINATES OF CORNERS OF WALL CROSS-SECTION

          X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
          Y-COORDINATES ARE ELEVATIONS

     PT.      X             Y                  DESCRIPTION OF POINT
     --  ---------  ----------  ------------------------------------
      1     0.          87.5000  BASIC WORKING POINT = TOE-SIDE OF STEM TOP
      2     0.          74.0000  BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
      3     0.          74.0000  BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
      4    -2.0000      74.0000  TOP OF TOEHT = AT OUTER END OF TW2
      5    -2.0000      72.5000  TOE END OF BASE = AT BTE1
     10     9.0000      72.5000  HEEL END OF BASE
     11     9.0000      74.0000  TOP OF HEELT2 = TOP OF OUTER END OF HEEL
     12     1.5000      74.0000  BOTTOM OF HEEL-SIDE FACE OF STEM
     13     1.0000      87.5000  BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
     14     1.0000      87.5000  TOP OF HEEL-SIDE FACE OF STEM
     15     8.5000      72.5000  BOTTOM OF CUTOFF WALL UNDER KEY


WITH BASE RADIUS ("BASER", 0.0 FOR RECTANGULAR) =       0.    FEET,
TOE END OF BASE UNIT WIDTH =    1.0000 FT. AND
HEEL END OF BASE UNIT WIDTH =   1.0000 FT.
(BASIC WORKING POINT IS 1.0 FT. WIDE).
```

```
WALL DATA LISTS:

WLA      ETS             TW2             STR             HEELW
      87.50000        2.000000        0.1818182       7.500000

WLAR     HW              HS                              BASER (LIST@WLAR)
      11.00000        0.                              0.

WLAH   HEELT2          HEELW          HEELT1
      18.00000        7.500000        18.00000

WLAK   KFLAG             DKEY            WKEY            BKTF
          0           0.              0.              100.0000

WLAS    TSTT            TSR             TSTR            WSTPW           WSTPB
      12.00000        0.              18.00000        0.              0.
     WSBPB
    0.4444444

WLAT    RTE1            TOEHT           TS2             TW1             TB1
      72.50000        18.00000        100.0000        0.              100.0000

----   TMINR           TMINS
    =0.1234000E 31  =0.1234000E 31


LOWEST CONCRETE =      72.50 FT.. AT HEEL END OF BASE
COMPARED WITH THE PREVIOUS LOW OF  72.500000     FT.

  ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE   1 ----------

FH TOP CALCULATED TO BE      72.499
FOR LOAD CASE  1

> NPPD   IS          3

  ---------------- END OF PRESSURE DATA VERIFICATION ----------------

DEFAULT VALUE OF     3000.000      USED FOR   FPCON     (LOAD CASE  1)

DEFAULT VALUE OF    0.2900000E 08  USED FOR    ESTL     (LOAD CASE  1)

DEFAULT VALUE OF     9.190000      USED FOR   RATION    (LOAD CASE  1)

DEFAULT VALUE OF    0.4500000      USED FOR   RATIOF    (LOAD CASE  1)

DEFAULT VALUE OF     20000.00      USED FOR   FSTLMX    (LOAD CASE  1)

DEFAULT VALUE OF            0      USED FOR    IFDR     (LOAD CASE  1)

DEFAULT VALUE OF     2.500000      USED FOR   COVHS     (LOAD CASE  1)

DEFAULT VALUE OF     2.500000      USED FOR   COVTS     (LOAD CASE  1)

DEFAULT VALUE OF     2.500000      USED FOR   COVTB     (LOAD CASE  1)

DEFAULT VALUE OF     3.500000      USED FOR   COVBR     (LOAD CASE  1)

DEFAULT VALUE OF     2.370000      USED FOR   SPARL     (LOAD CASE  1)

COMBINED PASSIVE PRESSURE VALUE OF  =10.55273     USED FOR LOAD CASE  1
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         16:56:20 ON 12/ 1/80


#
# BEGIN STRESS ANALYSIS
#
```

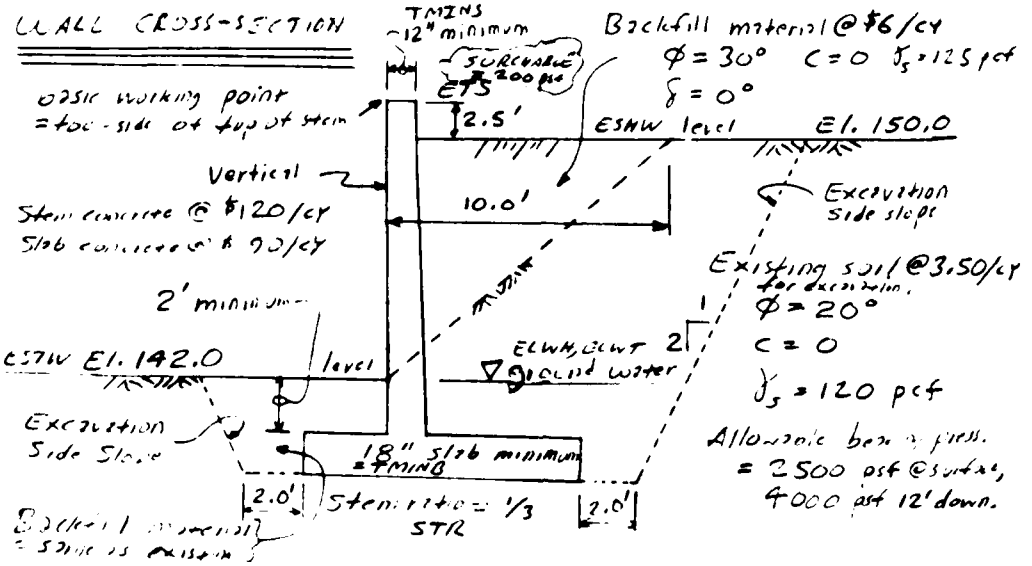
```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         16:57:54 ON 12/ 1/80


#
# BEGIN STEM STRESS ANALYSIS
#


SHEAR AT A DISTANCE D ABOVE THE BASE--

---------- SECTION PROPERTIES AT ELEVATION     75.17 ----------
MOM.  COMP. FACE   OVERALL   EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE       K        J
----  ----------  ---------  ----------  -----------  -------  -------  -------
 +       12.00      17.48       14.98        0.79       HEEL
 -       12.00      17.48       14.98        0.79       TOE

--- SHEAR ANALYSIS AT ELEVATION     75.17  (+ V FROM TOP PUSHED TOWARD TOE) ---
LOAD       V        N (COMP +)       M          UNIT SHEAR    ALLOWABLE  ACI318-77
CASE  LB / SLICE   LB / SLICE   LB-FT/SLICE  STRESS  PSI  UNIT STRESS PROVISION
----  ----------  ----------  -----------  ------------  ---------- ---------
 1      3643.6      2272.5       14726.       20.267       60.641     8.7.4.5

MOMENT AT THE BASE--

---------- SECTION PROPERTIES AT ELEVATION     74.00 ----------
MOM.  COMP. FACE   OVERALL   EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE       K        J
----  ----------  ---------  ----------  -----------  -------  -------  -------
 +       12.00      18.00       15.50        0.79       HEEL    0.243    0.919
 -       12.00      18.00       15.50        0.79       TOE     0.243    0.919

FLEXURE ANALYSIS AT ELEVATION     74.00 (+ M = TENSION AT HEEL)
LOAD   N (COMP+)       M          FC       FS
CASE  LB / SLICE  LB-FT/SLICE    PSI      PSI
----  ----------  -----------  -------  -------
 1       2531.       19227.     768.   18762.
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
          16:58:21 ON 12/ 1/80


#
# BEGIN TOE STRESS ANALYSIS
#


SHEAR AT A DISTANCE D FROM THE STEM--
<--- ANALYSIS WITHIN 1-FOOT OF END OF TOE IS MEANINGLESS ----


MOMENT AT THE STEM (POINT 2)--


----- SECTION PROPERTIES AT X = -0.001  ( 1.999 FEET FROM END OF TOE) -----
MOM.  COMP. FACE   OVERALL    EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE      K       J
----  ----------  ---------  ----------  -----------  -------  -----  -----
 +       12.00       18.00       15.50         0.79     TOP   0.243  0.919
 -       12.00       18.00       14.50         0.79     BOTT  0.250  0.917

FLEXURE ANALYSIS AT X = -0.001 ( 1.999 FROM END OF TOE) (+ M = TENSION IN TOP)
LOAD  N (COMP=+)       M          FC      FS
CASE  LB / SLICE  LB-FT/SLICE    PSI     PSI
----  ----------  -----------  -----  ------
 1          0.        -4344.    180.   4959.
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
        16:58:45 ON 12/ 1/80


#
# BEGIN HEEL STRESS ANALYSIS
#


SHEAR AND MOMENT AT THE STEM--


----- SECTION PROPERTIES AT X =  1.501  ( 7.499 FEET FROM END OF HEEL) ----
MOM.  COMP. FACE   OVERALL   EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE      K       J
----  ----------  ---------  ----------  -----------  -------  -----  -----
 +       12.00      18.00       15.50        0.79       TOP   0.243  0.919
 -       12.00      18.00       14.50        0.79       BOTT  0.250  0.917

--- SHEAR ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+V = END DOWN) ---
LOAD       V          N (COMP +)        M          UNIT SHEAR    ALLOWABLE   ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS PROVISION
----  ----------    ----------   -----------   -----------   ----------- ----------
 1      3940.7        1218.0        20848.        21.187        60.453     8.7.4.5

FLEXURE ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD   N (COMP=+)        M          FC      FS
CASE   LB / SLICE   LB-FT/SLICE    PSI     PSI
----   ----------   -----------   -----  ------
 1        1218.        20848.      802.  21394.


SHEAR AND MOMENT AT X =   2.000


----- SECTION PROPERTIES AT X =  2.000  ( 7.000 FEET FROM END OF HEEL) ----
MOM.  COMP. FACE   OVERALL   EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE      K       J
----  ----------  ---------  ----------  -----------  -------  -----  -----
 +       12.00      18.00       15.50        0.79       TOP   0.243  0.919
 -       12.00      18.00       14.50        0.79       BOTT  0.250  0.917

--- SHEAR ANALYSIS AT X =  2.000 ( 7.000 FROM END OF HEEL) (+V = END DOWN) ---
LOAD       V          N (COMP +)        M          UNIT SHEAR    ALLOWABLE   ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS PROVISION
----  ----------    ----------   -----------   -----------   ----------- ----------
 1      3984.2        1218.0        18869.        21.421        60.453     8.7.4.5

FLEXURE ANALYSIS AT X =  2.000 ( 7.000 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD   N (COMP=+)        M          FC      FS
CASE   LB / SLICE   LB-FT/SLICE    PSI     PSI
----   ----------   -----------   -----  ------
 1        1218.        18869.      728.  19284.

#
# MODULE WA COMPLETE
#

#
# UPDATE FILE RESET
#

COMMAND ENTERED:
END
```

EXAMPLE 2: DESIGN OF A BASIC RETAINING WALL

2-1



Problem: Vary base embedment and width to get cheapest wall to extend soil level 9'. Minimum earth cover over toe = 2.0'. Assume ground water drained down to El. 142.

DATA PREPARATION

Starting Responses, paragraphs 7.1, 7.2a

INIT (new problem)
1 (1 load case)
R (retaining wall)
H (hydraulic structure)
NAME EXAMPLE 2 -- BASIC RET WALL DESIGN

Selection of data lists, paragraphs 3.2 and 8.1 through 8.1.3

Module FD for foundation design:
1. SSMC SST SPEC LOAD WALL INPUT required
2. NA = SSCF ... LOAD optional

Preparation of Data Lists, paragraphs 8.3 – 8.12

Soil Surfaces (data lists beginning with letters "SS")

* Finished Grade over Heel, paragraph 8.3.1 a

list name	LC	ESHW feet	HS3
SSHC	0	150.0	100.0 ← level

* Finished Grade over Toe, paragraph 8.3.1 b

list name	LC	ESTW	SST
SST	0	142.0	100.0

* Existing Grade, paragraph 8.3.2 (list SSEE)

EXW = 2.0 ft.

ESS = 0.5 ft horiz per foot vertical (1H:2V)

HSSST = 100.0 (level) on toe-side (0 ok)

ELTSST = 142.0 elev. on toe-side (0 ok)

DTSST = 10' = imaginary on level surface

ELTSSW = 142.0 under base working point

ELTSSH = 150.0 elev at DTSSH from base working point

DTSSH = 10.0 feet from base working point to ELTSSH

HSSSH = 100.0 = level beyond DTSSH

SSEE 2.0 0.5 100.0 142.0 10.0 142.0 150.0 10.0 100.0

Soil Properties (data lists beginning with the letters "SP"):

* Existing soil, paragraph 8.4.1:

list name	PHI3 Φ	COH3 C psf	GAMHS3 γ_s pcf	PHIS3 Φ sliding	ADHS3 adhesion psf
SPE3	20.0	0	120.0	20.0	0

ABP3TN @ Surface BW = BW1	ABP3BN @ El. 130 BW = BW1	ABP3TW @ Surface BW = BW2	ABP3BW @ El. 130 - BW = BW2	LLBS3
2500.0	4000.0	2500.0	4000.0	130.0

* Heel Backfill, paragraph 8.4.2 a:
This list is needed because ϕ, c, and δ are different from SPE3

list name	LC	PHI1	COHI psf	GAMASI pcf	RKAI coward	DELTAI δ	RKAEI earthquake	HCMIN
SPHI	0	30.0	0.0	125.0	C	0.0	C	D

Toe Backfill, paragraph 8.4.2 b:
This list is not needed because the properties are the same as in list SPE3.

Foundation Design Parameters

With no earthquake and not-arching active, data list SOLP is not needed.

Data list RRO is not needed because the default value of 1/3 (ETS-ELWH > 1.05') is acceptable for a retaining wall.

Water, paragraph 8.6

* Seepage, paragraph 8.6.1:

data list name	LC	ELWT over toe feet	ELWH over heel feet
SEEP	0	142.0	142.0

HGSW, ISLC, ISET, KRACK are to be the default values, so skip list here

* Boil control is not applicable with ELWT = ELWH so do not use list BOIL.

Surcharges, paragraph 8.7

Distributed surcharge over heel, so use list SCWV in paragraph 8.7.2: See also Figure 4.

list name	LC	WT psf	WWT feet	OWT feet	WH psf	WWH feet	OWH feet
SCWV	0	0.0	0.0	0.0	200.0	100.0	2.0

Wall Geometry Data, paragraph 8.8:

1. Use data lists with names beginning with WLD, standing for "Wall Design"; WLD, WLDB, WLDT are required.
2. Omit list WLDH because TMINB is acceptable for HBOLT2
3. Omit list WLDK because there is no key
4. Use list WLDS because TMINS is to be held at 12" when (ETS - BTE1) goes over 15' as BTE1 goes from BTE11 to BTE12.

list name	ETS feet	TW2 feet	STR	HEELW feet	TSTB inches	TMINB inches
WLD	152.5	C	0.333	C	C	18.0

to be calculated for strength

list name	BW1 feet	BW2 feet	BS1	BS2
WLDB	5.0	15.0	0.0	0.0

list name	TMINS inches	TSB in/ft	HSTPH feet	HSTPB in/ft	HSBPB in/ft
WLDS	12.0	0.0	0.0	0.0	C

list name	BTE11 feet	BTE12 feet	TOEHT inches	TW1 feet
WLDT	133.5	138.5	D	0.0

default to TMINB

BTE12 will probably control, with the level base and no key.

142.0 - 2 min. cover - 1.5' TOEHT

Selected to be below lowest probable most economical embedment

Reinforcing Steel Design, paragraphs 8.9 & 8.9.1

Data list COVR is not needed because all of the default values are acceptable. Note paragraph 8.9.5 b.

Concrete Design Parameters, paragraph 8.10

* Data list CND is needed, to set IFEM to 0 to get design for exact load case only:

list name	RATION Es/Ec	FPCON psi	ESTL psi	IFEM
CND	C	D	D	0

* Use data list CNWD to use IFDR=0 to get design for exact loadings only:

list name	RATIOF fc/fs	FYSTL psi	FSTLMX psi	IBSAME	IFDR
CNWD	D	D	D	0	0

* Data list STLD is not needed, since the default values are all acceptable.

Cost Data, paragraph 8.11:

* Backfill @ $6.00/cy = $0.22222/cf

list name	Unit costs $/cf				
	filter zone	layer 1	layer 2	layer 6	layer 7
CSTB	0.0	0.22222	0.0	0.0	0.22222

* Concrete @ $120/cy in stem and $90/cy in slab

list name	Unit costs $/CF		
	base slab	stem	key
CSTC	3.33333	4.44444	0.0

* Structural Excavation @ $3.50/cy

list name	Unit costs $/CF		
	layer 3	layer 4	layer 5
CSTE	0.12963	0.0	0.0

DATA FILE:

```
*[illegible]

1000 INIT
1010 1
1020 K
1030 H
1040 NAME  EXAMPLE [illegible]  BASIC [illegible] WALL DESIGN
2000 [illegible]
[illegible]
[illegible]
3000 [illegible] 4000 [illegible] 2500 [illegible]
3010 [illegible]
4000 [illegible] 14 [illegible] 14 [illegible]
5000 [illegible]
7000 [illegible]
7010 [illegible]
7020 [illegible]
7030 [illegible]
8000 END [illegible]
8010 [illegible]
9000 [illegible]
9010 [illegible] 4.44444 [illegible]
9020 [illegible]
9900 [illegible]
```

TIME-SHARING TERMINAL INPUT AND OUTPUT

```
[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]
ENTER [illegible] MACH[illegible]
[redacted]

[illegible]
ENTER [illegible] INTEGER [illegible]

[illegible]

[illegible] IN DATA [illegible]

[illegible] DATA [illegible]

[illegible]
```

```
#
# DATA FILE PROCESSING DONE
#
# RETURN TO INTERACTIVE INPUT
#

COMMAND
 GOTO EO
#
# BEGIN MODULE EO
#

###
###   PROGRAM WAS UNABLE TO DESIGN WALL WITHIN
###   THE DESIGN LIMITS SPECIFIED
###
###   AN ANALYSIS OF THE LAST TRY AT A DESIGN
###   WITHIN THE SPECIFIED LIMITS FOLLOWS
###


BASE REJECTION
    DATA    LOWEST      BETWEEN THE LIMITS
    ITEM    COST
    NAME    VALUE       LOWER      UPPER                 EXPLANATION
    ----    -----       -----      -----                 -----------
    BTET     155.50      155.50     190.50   FIXED AT MINIMUM OR FOR END
    BW        15.00        5.00      15.00   BASE WIDTH
    BS         0            0          0     BASE SLOPE = VERT. TO 1 HORIZ.
    UNIT       0            0          0     NET LEN. OF WALL BASE


#
# BEGIN MODULE EA
#


EO  RESULTANT RATIO =       0.4474, FOR LOAD CASE   1


FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.80, FOR LOAD CASE   1
BY SHEAR FRICTION METHOD


TOTAL COST =          396.59  ($/LF), FOR LOAD CASE   1


### WITH UPDATE FILE NOT RESET.

#
# UPDATE FILE RESET
#


#
# COMMAND-DATA PHASE ENTERED
#

COMMAND
/WIDTH  5.0   30.0   5.   5.

COMMAND
/RUN EO
#
# BEGIN MODULE EO
#
```

```
FOUNDATION STABILITY DESIGN SUMMARY--


BASE DESCRIPTION
    DATA    LOWEST      BETWEEN THE LIMITS
    ITEM    COST
    NAME    VALUE       LOWER       UPPER              DESCRIPTION
    ELEV    138.00      133.50      138.50    ELEV. OF BOTTOM OF TOE END
    BW       10.50        5.00       30.00    BASE WIDTH
    BS          0           0           0     BASE SLOPE, X VERT. TO 1 HORIZ
    DKEY        0           0           0     KEY LENGTH BELOW BASE


#
# BEGIN MODULE FA
#


THE RESULTANT RATIO =        0.5602  FOR LOAD CASE   1


FINAL FACTOR OF SAFETY AGAINST SLIDING =       2.00  FOR LOAD CASE   1
BY SHEAR FRICTION METHOD


TOTAL COST =          278.91   ($/LF), FOR LOAD CASE   1

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD )
   OR 0 TO OMIT THE PLOTS
?0

#
# UPDATE FILE RESET
#


#
# COMMAND-DATA PHASE ENTERED
#

COMMAND
/RUN WD
#
# BEGIN DATA CHECK FOR MODULE WD
#

COMPLETE THE TRIAL WALL DESCRIPTION

#
```

```
# BEGIN ALTERNATE METHOD (WSD) DESIGN
#

#
# DESIGN SUMMARY
#

WEA       FYS               TW2              STR               HEFFW
     152.5000          6.166667        0.5555555          11.24251

WEAB      BW                BS                                 BASE (CONST WEBB)
     18.50000        0                                  0

WEAH   HEFF12            HEFFW            HEFFFT
     18.00000        11.24251         15.00000

WEAN   NFLAG             DNFY             WNFY              RNTF
          0          0                0                  5.000000

WEAS     TSFF             TSR              TSFR              HSTFM             HSTFB
     12.00000        0                13.09225          0                  0
       HSDFB
   0.840192E-01

WEAT     FYFT             TOLHT            TS2               TW1               TS1
     158.0000        18.00000         100.0000          0                  100.0000

       TMINB            TMINS
     18.00000        12.00000

#
# UPDATE FILE RESET
#


#
# COMMAND DATA PHASE ENTERED
#

COMMAND
=END

ENTER 5 TO SEND REPORT TO AUTO TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT -
=5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
=80

SNUMB # 3017R

your update file for future restart is named FX2UPD

stop     OK (release unneeded files)

*
```

REPORT FILE (PRINTED AT COPE TERMINAL):

```
&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&
          16:49: 3 ON 11/26/80



 NOTES TO EXPLAIN SPECIAL PRINTOUT THAT MIGHT BE IN THIS FILE**

 THE VALUE "-.1234E+31" IS USED TO DENOTE AN  UNDEFINED ITEM;
 THE VALUE "-.1432E+31" MEANS THAT THE DEFAULT VALUE WAS REQUESTED.

 A "MEMORY FAULT AT ..." MESSAGE PROBABLY MEANS THAT NEEDED DATA IS UNDEFINED.


 END OF NOTES.

 COMMAND ENTERED:
 INIT

 ** ALL DATA RESET FOR FRESH START **

 COMMAND ENTERED:
 R

 COMMAND ENTERED:
 H
```

```
          16:49:18 ON 11/26/80

WALL DECLARED TO BE A HYDRAULIC RETAINING WALL


COMMAND ENTERED:
NAME  EXAMPLE 2 ==  BASIC RET WALL DESIGN

COMMAND ENTERED:
SSHC  0  150.0  100.0

COMMAND ENTERED:
SST   0  142.0  100.0

COMMAND ENTERED:
SSEE 2.0 0.5 100.0 142.0 10.0 142.0 150.0 10.0 100.0

COMMAND ENTERED:
SPE3 20.0 0.0 120.0 20.0 0.0  2500.0 4000.0 2500.0 4000.0 130.0

COMMAND ENTERED:
SPH1  0  30.0  0.0  125.0  C  0.0  C  D

COMMAND ENTERED:
SEEP  0  142.0  142.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
SCWV  0  0.0  0.0  0.0  200.0  100.0  2.0

COMMAND ENTERED:
WLD  152.5  C  0.333  C  C  18.0

COMMAND ENTERED:
WLDB  5.0  15.0  0.0  0.0

COMMAND ENTERED:
WLDS  12.0  0.0  0.0  0.0  C

COMMAND ENTERED:
WLDT  133.5  138.5  D  0.0

COMMAND ENTERED:
CND  C  D  D  0

COMMAND ENTERED:
CNWD  D  D  D  0  0

COMMAND ENTERED:
CSTB  0.0  0.22222  0.0  0.0  0.22222
```

```
COMMAND ENTERED:
CSTC  3.33333  4.44444  0.0

COMMAND ENTERED:
CSTE  0.12963  0.0  0.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - CSTE
TRAILING VALUES SET TO '0'

COMMAND ENTERED:
UPDATE

#
# UPDATE FILE RESET
#


COMMAND ENTERED:


COMMAND ENTERED:
RUN FD
```

```
EXAMPLE 2 ** BASIC RET WALL DESIGN
         16:51: 1 ON 11/26/80

#
# BEGIN MODULE FD
#

SUBR FD, WARNING, VARIABLE ELSPT UNDEFINED,
CREEP RATIO WILL BE CALCULATED WITHOUT SHEET PILE CUTOFF.
SUBR FD, WARNING, VARIABLE CRMIN UNDEFINED,
SHEET PILE TIP ELEVATION WILL NOT BE CALCULATED.

###
###  PROGRAM WAS UNABLE TO DESIGN WALL WITHIN
####  THESE DESIGN &LIMITS SPECIFIED
###
###  AN ANALYSIS OF THE LAST TRY AT A DESIGN
###  WITHIN THE SPECIFIED LIMITS FOLLOWS:
###


BASE DESCRIPTION:
   DATA   LOWEST     BETWEEN THE LIMITS
   ITEM    COST      ******************
   NAME    VALUE       LOWER      UPPER              DESCRIPTION
   ****  *********  ********   *******  ***************************
   ATEI     133.50     133.50     138.50  ELEV. OF BOTTOM OF TOE END
   BW        15.00       5.00      15.00  BASE WIDTH
   BS       0.          0.         0.     BASE SLOPE, X VERT. TO 1 HORIZ.
   DKEY       0.          0.         0.   KEY LENGTH BELOW BASE


#
# BEGIN MODULE FA
#
```

The following report file sections are similar in content, with different numbers, to those for Example 1. They are not shown in this user's guide but are shown in the program validation report.

Data check for Module FA
Data check for Active Earth Pressures
Overturning Computation
Sliding Computation

```
#
# EXIT MODULE FA
#

 CREEP RATIO CALCULATED WITHOUT SHEET PILE CUTOFF =      0.

 #
 # UPDATE FILE RESET
 #

 COMMAND ENTERED:
 WLOB  5.0  10.0  S  S

 COMMAND ENTERED:
 RUN FD
```

```
EXAMPLE 2 ** BASIC RET WALL DESIGN
        16:54:24 ON 11/26/80

#
# BEGIN MODULE FD
#

SUBR FD, WARNING, VARIABLE ELSPT UNDEFINED,
CREEP RATIO WILL BE CALCULATED WITHOUT SHEET PILE CUTOFF,
SUBR FD, WARNING, VARIABLE CRMIN UNDEFINED,
SHEET PILE TIP ELEVATION WILL NOT BE CALCULATED,

FOUNDATION STABILITY DESIGN SUMMARY**

BASE DESCRIPTION:
   DATA    LOWEST     BETWEEN THE LIMITS
   ITEM     COST      ------------------
   NAME     VALUE       LOWER      UPPER              DESCRIPTION
   ----  ---------   --------   --------   ----------------------------**
   BTE1     138.00      133.50     138.50   ELEV. OF BOTTOM OF TOE END
   BW        18.50        5.00      30.00   BASE WIDTH
   BS      0.           0.         0.       BASE SLOPE, X VERT. TO 1 HORIZ.
   DKEY      0.           0.         0.     KEY LENGTH BELOW BASE


#
# BEGIN MODULE FA
#
```

The following report file sections are similar in content, with different numbers, to those for Example 1. They are not shown in this user's guide but are shown in the program validation report.

Data check for Module FA
Data check for Active Earth Pressures
Overturning Computation
Sliding Computation

```
#
# UPDATE FILE RESET
#

COMMAND ENTERED:
RUN WD
```

```
EXAMPLE 2 ##  BASIC RET WALL DESIGN
        17: 41  0 ON 11/26/80

#
# BEGIN DATA CHECK FOR MODULE #0
#

COMPLETE THE TRIAL WALL DESCRIPTIONS

DEFAULT VALUE OF    0.            USED FOR RASER       (LOAD CASE  1)

DEFAULT VALUE OF    12.00000      USED FOR TSTT        (LOAD CASE  1)

DEFAULT VALUE OF    18.00000      USED FOR TOEHT       (LOAD CASE  1)

DEFAULT VALUE OF    100.0000      USED FOR TS2         (LOAD CASE  1)

DEFAULT VALUE OF    18.00000      USED FOR HEELT2      (LOAD CASE  1)

DEFAULT VALUE OF          0       USED FOR KFLAG       (LOAD CASE  1)

DEFAULT VALUE OF    3.000000      USED FOR BKTF        (LOAD CASE  1)

TW2    CALCULATED TO BE      0.1667

WITH BASE RADIUS ("RASER", 0.0 FOR RECTANGULAR) =       0.   FEET,
TOE END OF BASE UNIT WIDTH =   1.0000 FT, AND
HEEL END OF BASE UNIT WIDTH =  1.0000 FT,
(BASIC WORKING POINT IS 1.0 FT. WIDE).

LOWEST CONCRETE =     138.00 FT., AT HEEL END OF BASE

DEFAULT VALUE OF          11      USED FOR   MAXBAR    (LOAD CASE  1)

SPAMIN CALCULATED TO BE      3.6600

MAXIMUM STEEL AREA PER FOOT, CALCULATED FROM
NO. 11 BARS (MAXBAR) AT  3.66 INCHES (SPAMIN),
IS  5.115 SQ. IN. / FT.

  ********** PRESSURE DATA VERIFICATION FOR LOAD CASE    1 **********

FH TOP CALCULATED TO BE      142.00
FOR LOAD CASE  1

> NPPD   IS          5

DEFAULT VALUE OF    1.000000      USED FOR  AOSF(LC)   (LOAD CASE  1)

  ********************* END OF PRESSURE DATA VERIFICATION *****************

DEFAULT VALUE OF    3000.000      USED FOR   FPCON      (LOAD CASE  1)

DEFAULT VALUE OF   0.29000000E OR USED FOR    ESTL      (LOAD CASE  1)

DEFAULT VALUE OF    9.190000      USED FOR   RATION     (LOAD CASE  1)
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	152.5000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.	139.5000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0.	139.5000	BET-EEN TS1 AND TS2, ON TOP FACE OF TOE
4	-6.1667	139.5000	TOP OF TOEHT = AT OUTER END OF TW2
5	-6.1667	138.0000	TOE END OF BASE = AT BTE1
10	12.3333	138.0000	HEEL END OF BASE
11	12.3333	139.5000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.4589	139.5000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.0000	152.5000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.0000	152.5000	TOP OF HEEL-SIDE FACE OF STEM
15	11.8333	138.0000	BOTTOM OF CUTOFF WALL UNDER KEY

DEFAULT VALUE OF 0.3500000 USED FOR RATIOF (LOAD CASE 1)

DEFAULT VALUE OF 20000.00 USED FOR FSTLMX (LOAD CASE 1)

DEFAULT VALUE OF 3.500000 USED FOR COVHS (LOAD CASE 1)

DEFAULT VALUE OF 3.500000 USED FOR COVTS (LOAD CASE 1)

DEFAULT VALUE OF 3.500000 USED FOR COVTB (LOAD CASE 1)

DEFAULT VALUE OF 4.500000 USED FOR COVBH (LOAD CASE 1)

DEFAULT VALUE OF 2.375000 USED FOR SPARL (LOAD CASE 1)

COMBINED PASSIVE PRESSURE VALUE OF 0. USED FOR LOAD CASE 1

```
EXAMPLE 2 ** BASIC WET WALL DESIGN
          17: 41  1 ON 11/26/80


*
* BEGIN ALTERNATE METHOD (=SO) DESIGN
*

THE ABOVE TABLE OF X= AND Y=COORDINATES AND THE FOLLOWING TABLE OF DATA
LISTS DESCRIBE THE WALL ASSUMED FOR THE DESIGN ANALYSIS FREE MODIES.
IF THE FINAL DIMENSIONS TURN OUT TO BE SUBSTANTIALLY DIFFERENT,
YOU MAY WANT TO RUN MODULE #1 AGAIN.


*LA      FYS             T=2             STR             HEELH
      152.5000        0.1000007       0.3333333       10.87438

*LAR     H=              HS                              BASEH (LIST=*LHH)
      18.50000        0.                              0.

*LAH   HEELT2          HEEL=           HEELT1
      18.00000        10.87438        18.00000

*LAH   KFLAG           DKEY            =KEY            FKTF
          0           0.              0.              5.000000

*LAS    TSTT            TSH             TSTH            HSTPH           HSTPH
      12.00000        0.              17.50759        0.              0.
      HSHPH
     0.8173775

*LAT    RTF1            TOEHT           TS2             T=1             TS1
      138.0000        18.00000        100.0000        0.              *0.1234000E 31

****   TWINH           TWINS
      18.00000        12.00000

*
* BEGIN TOE DESIGN
*

P T REINF, TA AND INCREASE THICKNESS AS NEEDED FOR SHEAR

*
* BEGIN STEM DESIGN
*

P T REINF, TA AND INCREASE THICKNESS AS NEEDED FOR SHEAR

*
* HEEL DESIGN
*

P T REINF, TA AND INCREASE THICKNESS AS NEEDED FOR SHEAR
```

```
*
* DESIGN SUMMARY
*

*LA      ETS             TW2             STR             HFEL*
      152.5000        6.166667        0.4333333       11.24231

*LAH     HW              BS                              BASER (LIST=*LBR)
      18.50000        0.                              0.

*LAH   HFELT2          HFEL*          HEELT1
      18.00000        11.24231        18.00000

*LAK   KFLAG             DKEY            *KEY            BKTF
         0            0.              0.              3.000000

*LAS    TSTT            TSB             TSTA            *STPH           *STPB
      12.00000        0.              13.09225        0.              0.
       *SHPB
    0.8401921E-01

*LAT    BTE1            TOEMT           TS2             TW1             TS1
      138.0000        18.00000        100.0000        0.              100.0000

****    TMINB           TMINS
      18.00000        12.00000
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	152.5000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.	139.5000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0.	139.5000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-6.1667	139.5000	TOP OF TOEMT = AT OUTER END OF TW2
5	-6.1667	138.0000	TOE END OF BASE = AT BTE1
10	12.3333	138.0000	HEEL END OF BASE
11	12.3333	139.5000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.0910	139.5000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.0000	152.5000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.0000	152.5000	TOP OF HEEL-SIDE FACE OF STEM
15	11.8333	138.0000	BOTTOM OF CUTOFF WALL UNDER KEY

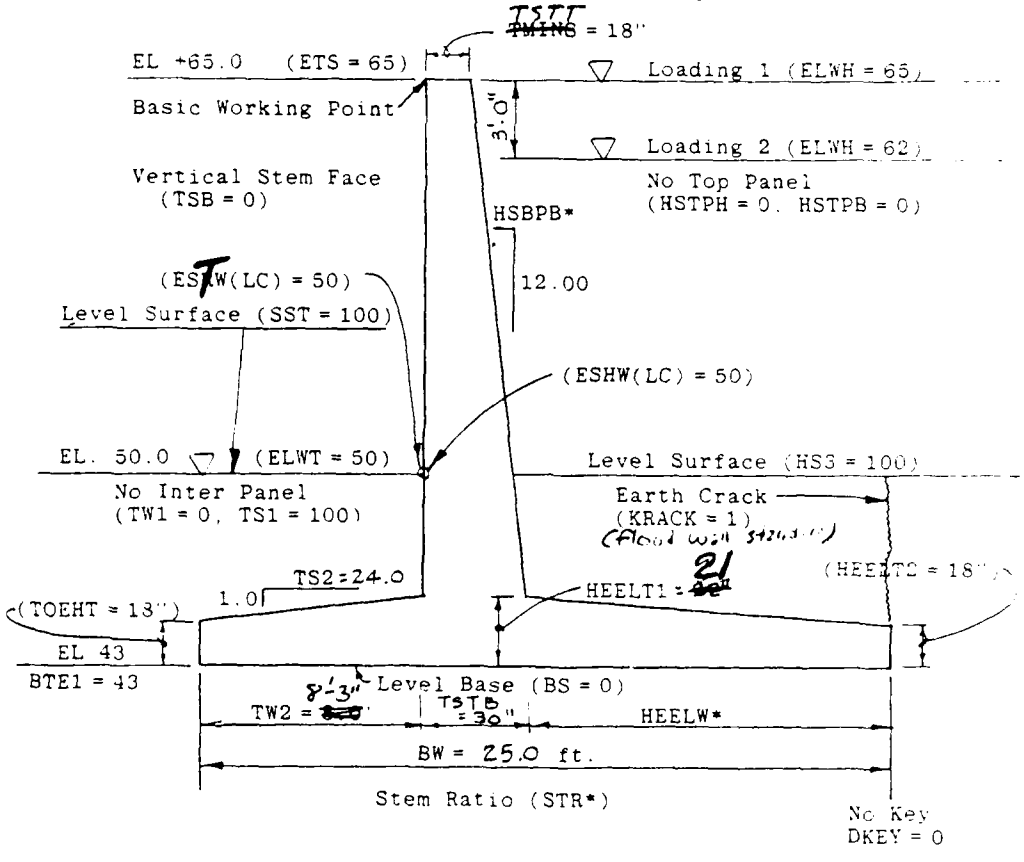
```
THE REINFORCING IN THE FOLLOWING TABLE SATISFIES STRENGTH AND
EM 1110-2-2103 MINIMUM REQUIREMENTS (.125 PERCENT OF AREA IN EACH FACE).

  TABLE OF STEEL VALUES IN STEM, SQ. IN. / FT.
   M    ELEV.   ASTLST(M)  ASTLSH(M,1) ASTLSH(M,2) ASTLSH(M,3)
   1  152.50      0.181       0.181      ******      ******
   2  151.50      0.181       0.181      ******      ******
   3  150.50      0.183       0.183      ******      ******
   4  149.50      0.184       0.184      ******      ******
   5  148.50      0.185       0.185      ******      ******
   6  147.50      0.186       0.186      ******      ******
   7  146.50      0.188       0.188      ******      ******
   8  145.50      0.189       0.189      ******      ******
   9  144.50      0.190       0.190      ******      ******
  10  143.50      0.191       0.197      ******      ******
  11  142.50      0.193       0.308      ******      ******
  12  141.50      0.194       0.449      ******      ******
  13  140.50      0.195       0.624      ******      ******
  14  139.50      0.196       0.829      ******      ******

  TABLE OF STEEL VALUES IN BASE, SQ. IN. / FT.
   (M = 1 AT END OF TOE)
   M    DIST.   ASTLBT(M,1) ASTLBT(M,2) ASTLBB(M,1) ASTLBB(M,2) ASTLBB(M,3)
   1    0.         0.270      ******      0.270      ******      ******
   2    1.00       0.270      ******      0.270      ******      ******
   3    2.00       0.270      ******      0.270      ******      ******
   4    3.00       0.270      ******      0.270      ******      ******
   5    4.00       0.270      ******      0.270      ******      ******
   6    5.00       0.270      ******      0.270      ******      ******
   7    6.00       0.270      ******      0.396      ******      ******
   8    7.00      ******      ******     ******      ******      ******
   9    8.00       0.270      ******      0.270      ******      ******
  10    9.00       0.270      ******      0.270      ******      ******
  11   10.00       0.270      ******      0.270      ******      ******
  12   11.00       0.270      ******      0.270      ******      ******
  13   12.00       0.270      ******      0.270      ******      ******
  14   13.00       0.270      ******      0.270      ******      ******
  15   14.00       0.270      ******      0.270      ******      ******
  16   15.00       0.270      ******      0.270      ******      ******
  17   16.00       0.270      ******      0.270      ******      ******
  18   17.00       0.270      ******      0.270      ******      ******
  19   18.00       0.270      ******      0.270      ******      ******

  ASTLK =   0.000   SQ IN / FT

  ****** = "UNDEFINED"

#
# UPDATE FILE RESET
#

COMMAND ENTERED!
END
```

14-3 EXAMPLE 3: ANALYSIS OF A BASIC FLOODWALL

3-1

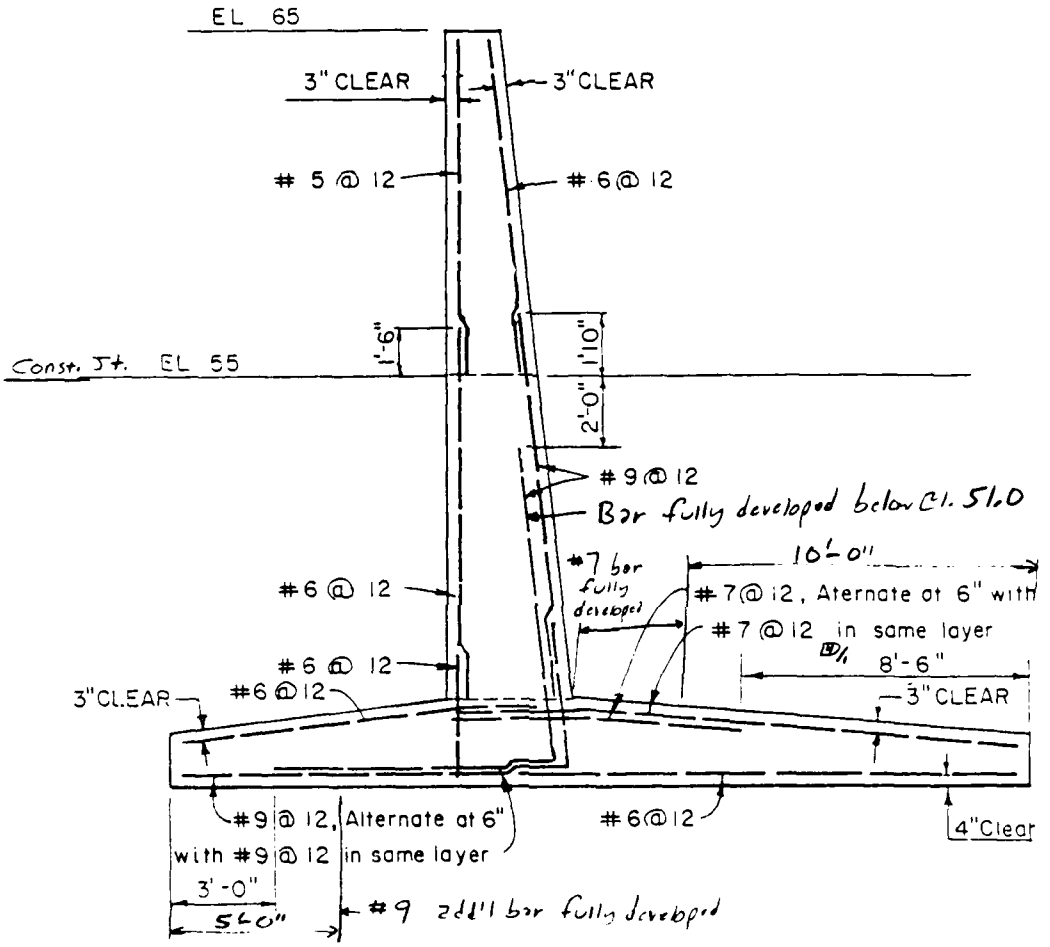
(Floodwall Example 1 (Analysis/Basic Wall)) EX3DATA

The objective of this example is to demonstrate stability and member analysis of a basic floodwall. The example is the same wall for the floodwall hand computation example. Data will be in a Command-Data file named ~~FWIEX1~~. Program control will be interactive at the time-share-terminal.



Soils Design Data (SPE3)
γ_s = 125 lb/cf (GAMAS3 = 125)
ϕ = 15° (PHI3 = 15)
C = 400 lb/sf (COH3 = 400)
Angle sliding friction on concrete = 15° (PH153 = 15)
Adhesive strength against concrete = 400 lb/sf
(ADHS3 = 400)

*To be calculated by program - input value of C in data.



DATA LIST [illegible] AND DEFAULT VALUES:

f_c = 3000 PSI
f'_c = 0.35 f_c = 1050 PSI (FOR HYDRAULIC STRUCTURES)
f_y = 40,000 PSI
f = 20,000 PSI (FOR HYDRAULIC STRUCTURES)

WALL REINFORCEMENT

DATA PREPARATION

Starting Responses paragraphs 7.1 and 7.2.a

INIT (new problem)
2 (2 load cases)
F (floodwall default values selected)
H (hydraulic structure default values selected)
NAME EXAMPLE 3 -- BASIC FLOOD WALL ANALYSIS

Selection of Data Lists, paragraphs 3.2 and 8.1 thru 8.1.3

Module FA for foundation analysis

Module WA for stress analysis

Preparation of Data Lists, paragraphs 8.3 - 8.12 :

Soil Surfaces (data lists beginning with the letters "SS"):

* Finished grade over the heel, paragraph 8.3.1.a

list name	LC	ESHW form	WS3
SSHC	0	50.0	100.0

(0 = "all load cases")

(100.0 ← level ground)

* Finished grade over the toe, paragraph 8.3.1.b

list name	LC	ESTW	SST
SST	0	50.0	100.0

Finished grade of existing soil is not applicable to this analysis so data list SS... is not needed.

Soil Properties (data lists beginning with the letters "SP"):

* Subgrade data list SPE3, paragraph 8.4.1:

list name	PHI3 Φ	COH3 C, psf	GAMAS3 γ_s, pcf	PHIS3 Φ sliding	ADNS3 sliding adhesion, psf	
SPE3	15.0	400.0	125.0	15.0	400.0	→ truncate the list here since allowable bearing pressures are not stated

Data lists SPH1 and SPT7 are not needed because the backfill soils data are the same as for the subgrade soil and the following default values are valid (paragraph 8.4.2 a):

RKA1 is to be calculated
DELTA1 is zero
RKAE1 is zero
HCMIN is immaterial for analysis.

Foundation Design parameters

Data list SOLP, paragraph 8.5.1, is not needed because all of the default values are acceptable.

Data list RRD, paragraph 8.5.2, is not needed for analysis.

Water

* Data list SEEP, paragraph 8.6.1:

list name	LC	ELWT feet	ELWH feet	
SEEP	1	50.0	65.0	→ truncate the list here since "C" is valid for the rest of the values in the list.
SEEP	2	50.0	62.0	

Data list BOIL is not needed because there are no data for sheet pile cutoff criteria.

Surcharge data lists are not needed (paragraph 8.7.1)

Wall geometry data for analysis, paragraph 8.9.4
(Data lists beginning with the letters "WLA"):

	list name	ETS feet	TW2 feet	STR	HEELW feet
★	WLA	65.0	8.25	C	C

	list name	BW feet	BW1 for ABP3 T_{BN}	BW2 for ABP3 T_{BW}	BS
★	WLAB	25.0	24.0	26.0	0.0

	list name	HEELT2 inches	HEELW feet	HEELT1 inches
★	WLAH	18.0	C	21.0

WLAK is not needed because there is no key

	list name	TSTT inches	TSB inches	TSTB inches	HSTPH feet	HSTPB in/ft	HSBPB in/ft
★	WLAS	18.0	0.0	30.0	0.0	0.0	C

	list name	BTE1 feet	TOEHT inches	TS2	TW1 feet	TS1
★	WLAT	43.0	18.0	24.0	0.0	100.0

WLBR is not needed since the wall alignment is straight

-- data complete for module FA --

Reinforcing Steel data, paragraph 8.9:

Data list COVR is not needed because the default values in paragraph 8.9.1 are acceptable.

☆ Stem, paragraph 8.9.2

at top (LOC=1): ASTLST(1) = #5@12 = 0.31 (11)/1

ASTLSH(1,1) = #6@12 = 0.44 (11)/1

at el. 55 (LOC=11): ASTLST(11) = #6@12 = 0.44 (11)/1

ASTLSH(11,1) = #9@12 = 1.00 (11)/1

at el. 51 (LOC=15): ASTLST(15) = same as above

ASTLSH(15,1) = #9@6 = 2.00 (11)/1

at el. 46 = top of base, steel is same as above

list name	LOC	ASTLST(LOC) (11)/1	LN	ASTLSH(LOC, LN) (11)/1
STLS	1	0.31	1	0.44
STLS	11	0.44	1	1.00
STLS	15	(5 or 0.44)	1	2.00

☆ Toe, paragraph 8.9.4 (2)

at outer end (LOC=1): ASTLBT(1,1) = #6@12 = 0.44 (11)/1

ASTLBB(1,1) = #9@12 = 1.00 (11)/1

5' from outer end (LOC=6): ASTLBT(6,1) = same

ASTLBB(6,1) = #9@6 = 2.00 (11)/1

@ 8' from outer end, steel is same as at 5' from outer end.

list name	LOC	LNA	ASTLBT(LOC, LNA) sq in/ft	LNB	ASTLBB(LOC, LNB) sq in/ft
STLB	1	1	0.44	1	1.00
STLB	6	1	(5 or 0.44)	1	2.00

★ Heel, paragraph 8.9.4 (6)

LOC value at outer end:

$BW + 1.9999 = 25.0 + 1.9999 = 26.9999$

(1.9999: 4 decimals; 26.9999: LOC = 26 @ end)

@ outer end (LOC = 26): ASTLBT(1,1) = #7@12 = 0.6 ⓘ/1

ASTLBB(1,1) = #6@12 = 0.44 ⓘ/1

10' from outer end (LOC = 16): ASTLBT(1,1) = #7@6 = 1.20 ⓘ/1

ASTLBB(1,1) = same as at end

Steel at stem is same as at LOC = 16

list name	LOC	LNA	ASTLBT(LOC,LNA) sq in/ft	LNB	ASTLBB(LOC,LNB) sq in/ft
STLB	26	1	0.60	1	0.44
STLB	16	1	1.20	1	(5 or 0.44)

Concrete analysis parameters, paragraph 8.10

Data lists CND and CNWD are not needed because all of the default values are acceptable.

Data list STLO is not applicable to analysis.

Cost data, paragraph 8.11

Not needed because there is no boundary defined between existing and backfill soil systems and because no cost data are given.

DATA READY -- BUILD DATA FILE

DATA FILE:

```
 LIST EX3DATA

1000 INIT
1010 2
1020 F
1030 H
1040 NAME EXAMPLE 3 -  BASIC FLOOD WALL ANALYSIS
2000 SSHC 0  50.0  100.0
2010 SST  0  50.0  100.0
3000 SPE3  15.0  400.0  125.0  15.0  400.0
3010 SEEP  1  50.0  65.0
3020 SEEP  2  50.0  62.0
4000 WLA  65.0  8.25  C  C
4010 WLAR  75.0  24.0  26.0  0.0
4020 WLAH  18.0  C  21.0
4030 WLAS  18.0  0.0  30.0  0.0  0.0  C
4040 WLAI  43.0  18.0  24.0  0.0  100.0
5000 SILS  1  0.31  1  0.44
5010 SILS  11  0.44  1  1.00
5020 SILS  15  S  1  2.00
5100 SILR  1  1  0.44  1  1.00
5110 SILR  6  1  S  1  2.00
5200 SILR  26  1  0.60  1  0.44
5210 SILR  16  1  1.20  1  S
6000 UPDATE
```

TIME-SHARING TERMINAL INPUT AND OUTPUT

```
*RUN WESLIB/TWDA,R

        12/01/80    11.855


PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
      REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EX3UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR  MAX
?M L  WAITES
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?EX3DATA
PROCESSING DATA FILE

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPE3
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'
```

```
$
$ UPDATE FILE RESET
$

$
$ DATA FILE PROCESSING DONE
$
$ RETURN TO INTERACTIVE INPUT
$

COMMAND
?RUN FA


THE RESULTANT RATIO =       0.2420, FOR LOAD CASE  1


THE RESULTANT RATIO =       0.3625, FOR LOAD CASE  2


FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.73, FOR LOAD CASE  1
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS


FINAL FACTOR OF SAFETY AGAINST SLIDING =      2.69, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS


TOTAL CONCRETE VOLUME =          81.82 (CU FT / LF), FOR LOAD CASE  1


TOTAL CONCRETE VOLUME =          81.82 (CU FT / LF), FOR LOAD CASE  2

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE.  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD )
   OR 0 TO OMIT THE PLOTS
?0

$
$ UPDATE FILE RESET
$


$
$ COMMAND--DATA PHASE ENTERED
$

COMMAND
?RUN WA
$
$ BEGIN MODULE WA
$

ENTER 1 TO SEE A TABLE OF X AND Y CORNER COORDINATES
   OR C TO CONTINUE WITHOUT SEEING THE TABLE
?C
```

```
TO GET DEFAULT VALUE FOR "IFEM", ANSWER NEXT QUESTION WITH A CARRIAGE RETURN

### IFEM IS NOT DEFINED, SO YOU MUST
    ENTER 0 TO USE LOAD CASES AS-IS
    OR    1 TO ALSO USE EM ALTERNATE SPECIAL LOADINGS
            (A CARRIAGE RETURN WILL INSERT THIS DEFAULT
            VALUE OF 1)
    OR    ? FOR MORE INFORMATION
    OR    C TO CONTINUE DATA CHECK WITHOUT COMPUTATIONS
    OR    * TO ABORT THE MODULE
?
DEFAULT VALUE OF            1 USED

$
$ BEGIN STRESS ANALYSIS
$

ENTER T TO GET THE ANALYSIS RESULTS AT YOUR TERMINAL
   OR R TO PUT THEM IN THE REPORT FILE
   OR B TO PUT THEM BOTH PLACES
?R

ENTER THE LOAD CASE NUMBER YOU WANT ANALYZED
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST "CASE"
   OR * TO STOP THE MODULE
?0

$
$ BEGIN STEM STRESS ANALYSIS
$

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *)
?C

STEM ANALYSIS COMPLETE TO BASE

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *)
?N

$
$ BEGIN TOE STRESS ANALYSIS
$

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *)
?C

TOE ANALYSIS COMPLETE TO STEM

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *)
?N
```

```
*
* BEGIN HEEL STRESS ANALYSIS
*

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *)
?N

*
* MODULE WA COMPLETE
*

*
* UPDATE FILE RESET
*


*
* COMMAND-DATA PHASE ENTERED
*

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
?RO

SNUMB # 7250A


your update file for future restart is named EX3UPD
stop    OK (release unneeded files)

*
```

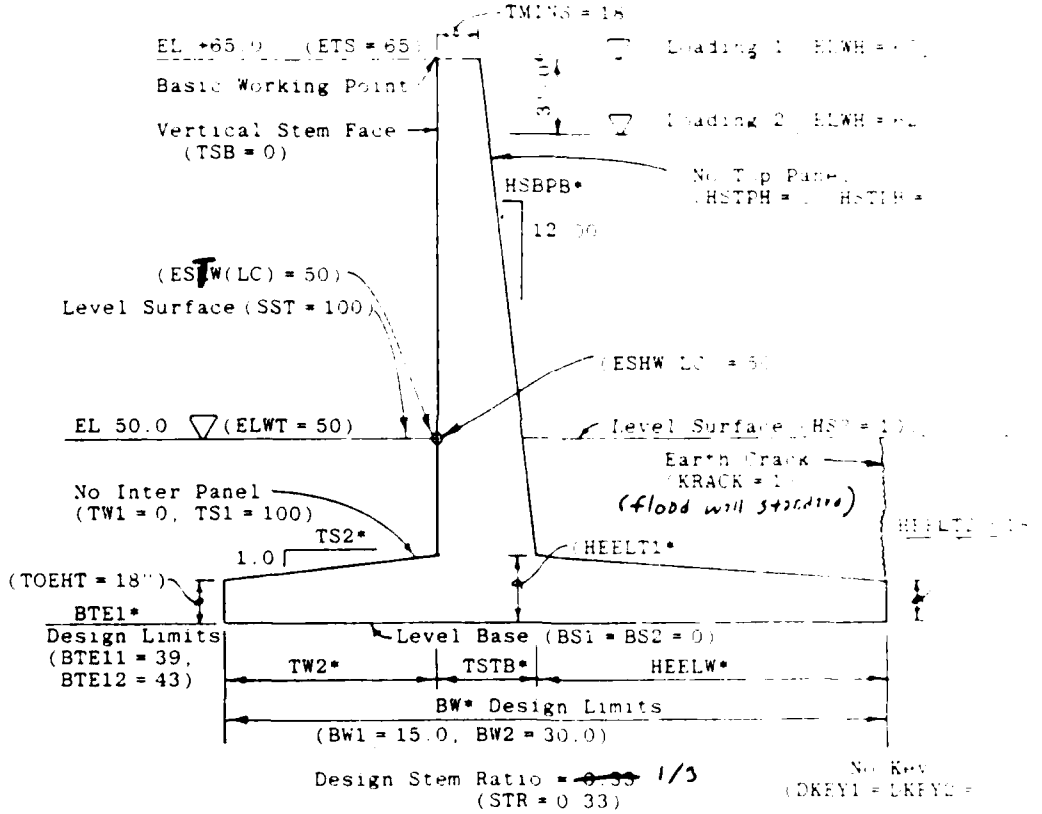
The report file for Example 3 is similar in form and messages to that for Example 1 and is not shown in this user's guide. It is shown in the program validation report.

14-4: EXAMPLE 4: DESIGN OF A BASIC FLOODWALL

4-1

(Floodwall Example 2 - Design Basic Wall) EX4 DATA

The objective of this example is to show the stability and member design of a basic floodwall. Wall and soil properties are the same as were used in floodwall analysis Example 1. Data will be in a Command-Data file named ~~FWEX2~~. Program control will be interactive at the time-share-terminal.



Soils Design Data (SPE3)
γ = 125 lb/cf (GAMAS3 = 125)
ϕ^s = 15° (PHI3 = 15)
C = 400 lb/sf (COH3 = 400)
Angle sliding friction on concrete = 15° PHI51 = 15)
Adhesive strength against concrete = 400 lb/sf
(ADHS3 = 400)

*To be calculated by program - input value of 0 in data

Allowable bearing pressures:

	BW1 = 15.0	BW2 = 30.0
El. 50.0	1500.0 psf	2500.0
El. 38.0	1820.0	2820.0

DATA PREPARATION

Convert the analysis problem in example 3 into design

Starting response, paragraph 4.2.1

[illegible] EX3[illegible]

[illegible] EXAMPLE 4 -- BASIC FLOOD WALL DESIGN

PREPARATION OF DATA LISTS, paragraph 8.1

Soil Surfaces (data lists beginning with the letters S[illegible])

Front grade, heel and toe = same as Example 3 no change

Existing grade, paragraph 8.3.2 = no change

Soil Properties (data lists beginning with letters SP)

Same as analysis example 3 = no changes for backfill

Data list SP[illegible] must be used again to enter the [illegible] [illegible] that were omitted in Example 3

★ Existing soil, paragraph 8.4.1

list name	PHI3 φ	C[illegible]3 psf	GAMS3 γ, pcf	PHIS3 φ [illegible]	ADHS3 adhesion psf
SPE?	S	S	S	S	S

these items do not change so the identifier S is used (see paragraph 5.3.3)

ABFSTN [illegible] [illegible] psf	ABFSTR [illegible] [illegible]	ABFBTN [illegible] surface [illegible] pcf	ABFBSW [illegible] [illegible] psf	ELBS3 feet
15000.0	1820.0	2[illegible].0	2820.0	38.0

Foundation Design Parameters, paragraph 8.5

With no extinguate and no arching active earth, data list SOLP (paragraph 8.5.1) is not needed.

Data list RRO (paragraph 8.5.2) is not needed because the default values of 1/4 for load case 1 (water within 1.05 ft. of top of wall) and 1/3 for load case 2 (water more than 1.05 ft. below top of wall) are acceptable.

Water, paragraph 8.6

no change, so data list SEEP is not needed.

Surcharges, paragraph 8.7

none, so omit these lists

Wall geometry, paragraph 8.8:

The data for analysis must be considered to data for design. The main concern in doing this is to make the dimensions desired to vary during the analysis are so specified. The fastest way for the beginning user is to cancel all geometry data not used. Study of paragraph 8.8.3 shows that these data lists are needed to cancel all analysis geometry data not to be entered for design: WLAB, WLAH, WLAK (if there is a key), WLAS, and WLAT

* WLAB C C C C
* WLAH C C C
* WLAS C C C C C C
* WLAT C C C C C

Note that only one "C" is actually needed because of the action described in paragraph 5.7.

New 3rd lists beginning with "WLD" to define design geometry:

1. Data list WLDH may be omitted because TMIND is acceptable for HEIGHT2 (see paragraph 8.8.2 b)
2. With no key, data list WLDK may be omitted.
3. Data list WLDS may be omitted because TMINS is acceptable for TSTT with height over 15'.

list name	CTS feet	TW2 feet	STR	HEIGW feet	TSTB inches	TMINB inches
★WLD	65.0	C	0.333	C	C	D

to be calculated for stiffness

the list may be truncated here because the remaining values are identifiers "C" or "D"

list name	BW1 feet	BW2 feet	BS1	BS2
★WLDB	15.0	30.0	0.0	0.0

list name	BTE11 feet	BTE12 feet	TOLHT inches	TW1 feet
★WLDT	39.0	43.0	D	0.0

default = TMIND, which itself defaults to 18" with data list WLDH omitted.

Reinforcing Steel data — read the first sentence in paragraph 8.9

Concrete Design Parameters paragraph 8.10

Data list CND will be used to keep the design to the data as input only (IRCM = 0).

Data list CWND will be used to keep the design based on full dead + live loads only, (IRCOR = 0)

All other values in data lists CND and CNWD may use their default values.

Data list STLD is not needed because its default values are acceptable.

*	list name	RATION $n = E_s/E_c$	IFPCON f'_c, psi	ESTL E_s, psi	I/ECM	
*	CND	D	D	D	O	

*	list name	RATIOF F_c/f'_c	FYSTL F_y, psi	FSTLMX $f_{s\,max}$, psi	IBSAME	IFDR
*	CNWD	D	D	D	D	O

Cost Data, paragraph 8.11 (data lists beginning "CST...")

Excavation and backfill costs are not given, so data lists CSTB and CSTE are not applicable and should be omitted.

Data list CSTC is needed, to enter values for

Stem concrete @ $120/cy = $4.444/CF

Slab concrete @ $90/cy = $3.333/CF

*	list name	base slab $/CB	stem $/CF	key $/CB
*	CSTC	3.3333	4.4444	0.0

ENTER DATA INTERACTIVELY

Note that the data could have been put in a data file, as described in paragraphs 6.1.1 b and 7.2.2.

TIME-SHARING TERMINAL INPUT AND OUTPUT:

```
*RUN WESLIB/TWDA,R

        12/01/80    12.308


PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EX4UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR  MAX
?M.I.  WATTS
ENTER YOUR MACON ACCOUNT NUMBER
?******

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?


IS THIS AN INITIAL RUN OR A RESTART OF A PREVIOUS RUN?
ENTER 'INIT' OR 'REST'

COMMAND
?REST EX3UPD

$-- ALL DATA RESET FOR FRESH START --$
$-- COMMON DATA RESET FROM RESTART FILE EX3UPD    UPDATE FILE RESET --$

COMMAND
?NAME EXAMPLE 4 -- BASIC FLOOD WALL DESIGN

COMMAND
?SPEC  S  S  S  S  S  1500.0  1820.0  2500.0  2820.0  38.0

COMMAND
?WLAB C

NOT ENOUGH VALUES ENTERED IN DATA LIST - WLAB
TRAILING VALUES SET TO 'C'

$$$ WARNING $$$ BW1 = BW2  CAN CAUSE  TROUBLE WITH ALLOWABLE BEARING PRESSURE


COMMAND
?WLAH C

NOT ENOUGH VALUES ENTERED IN DATA LIST - WLAH
TRAILING VALUES SET TO 'C'
```

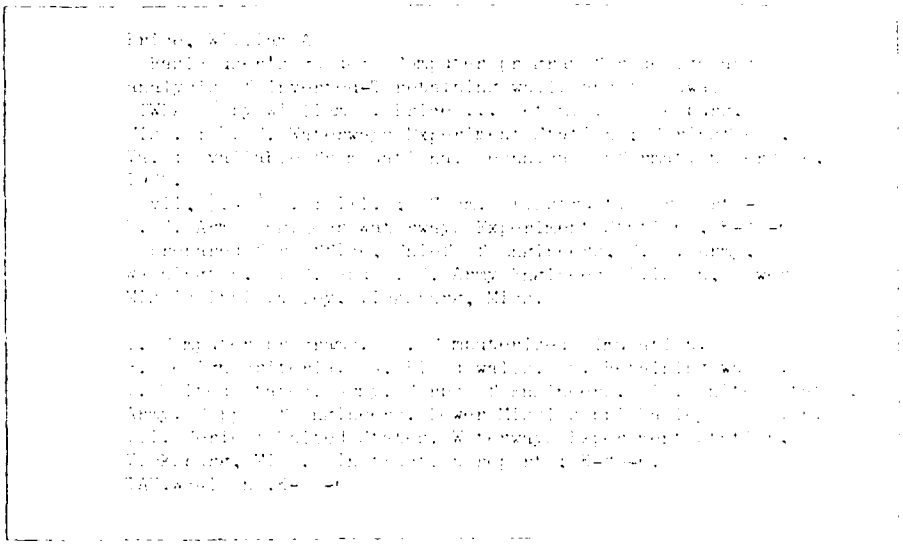
```
COMMAND
?WLAS C

NOT ENOUGH VALUES ENTERED IN DATA LIST - WLAS
TRAILING VALUES SET TO 'C'

COMMAND
?WLAT C

NOT ENOUGH VALUES ENTERED IN DATA LIST - WLAT
TRAILING VALUES SET TO 'C'

COMMAND
?WLD  65 0  C  0 333

NOT ENOUGH VALUES ENTERED IN DATA LIST - WLD
TRAILING VALUES SET TO 'C'

COMMAND
?WLDB  15 0  30 0  0.0  0 0

COMMAND
?WLDT  39 0  43 0  D  0 0

COMMAND
?CND  D  D  D  0

COMMAND
?CNWD  D  D  D  D  0

COMMAND
?CSTC  3 33333  4 44444  0 0

COMMAND
?UPDATE

$
$ UPDATE FILE RESET
$



COMMAND
?RUN FD
$
$ BEGIN MODULE FD
$


FOUNDATION STABILITY DESIGN SUMMARY--


BASE DESCRIPTION
   DATA    LOWEST     BETWEEN THE LIMITS
   ITEM     COST      ------------------
   NAME     VALUE       LOWER      UPPER              DESCRIPTION
   ----  ----------  ----------  ----------  ------------------------------
   BTE1      43.00       39.00       43.00  ELEV. OF BOTTOM OF TOE END
   BW        25.00       15.00       30.00  BASE WIDTH
   BS     0             0           0       BASE SLOPE, X VERT. TO 1 HORIZ
   DKEY      0.          0.          0.     KEY LENGTH BELOW BASE
```

```
#
# BEGIN MODULE FA
#


THE RESULTANT RATIO =       0.2555, FOR LOAD CASE  1

THE RESULTANT RATIO =       0.3674, FOR LOAD CASE  2


FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.75, FOR LOAD CASE  1
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS


FINAL FACTOR OF SAFETY AGAINST SLIDING =      2.73, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS


TOTAL COST =         352.97  ($/LF), FOR LOAD CASE  1


TOTAL COST =         352.97  ($/LF), FOR LOAD CASE  2

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD.)
   OR 0 TO OMIT THE PLOTS
?0

#
# UPDATE FILE RESET
#


#
# COMMAND-DATA PHASE ENTERED
#

COMMAND
?RUN WD
#
# BEGIN DATA CHECK FOR MODULE WD
#

COMPLETE THE TRIAL WALL DESCRIPTION:

#
# BEGIN ALTERNATE METHOD (WSD) DESIGN
#

ENTER THE LOAD CASE NUMBER YOU WANT TO DESIGN FOR
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST 'CASE'
   OR A * TO ABORT THE MODULE
?0
```

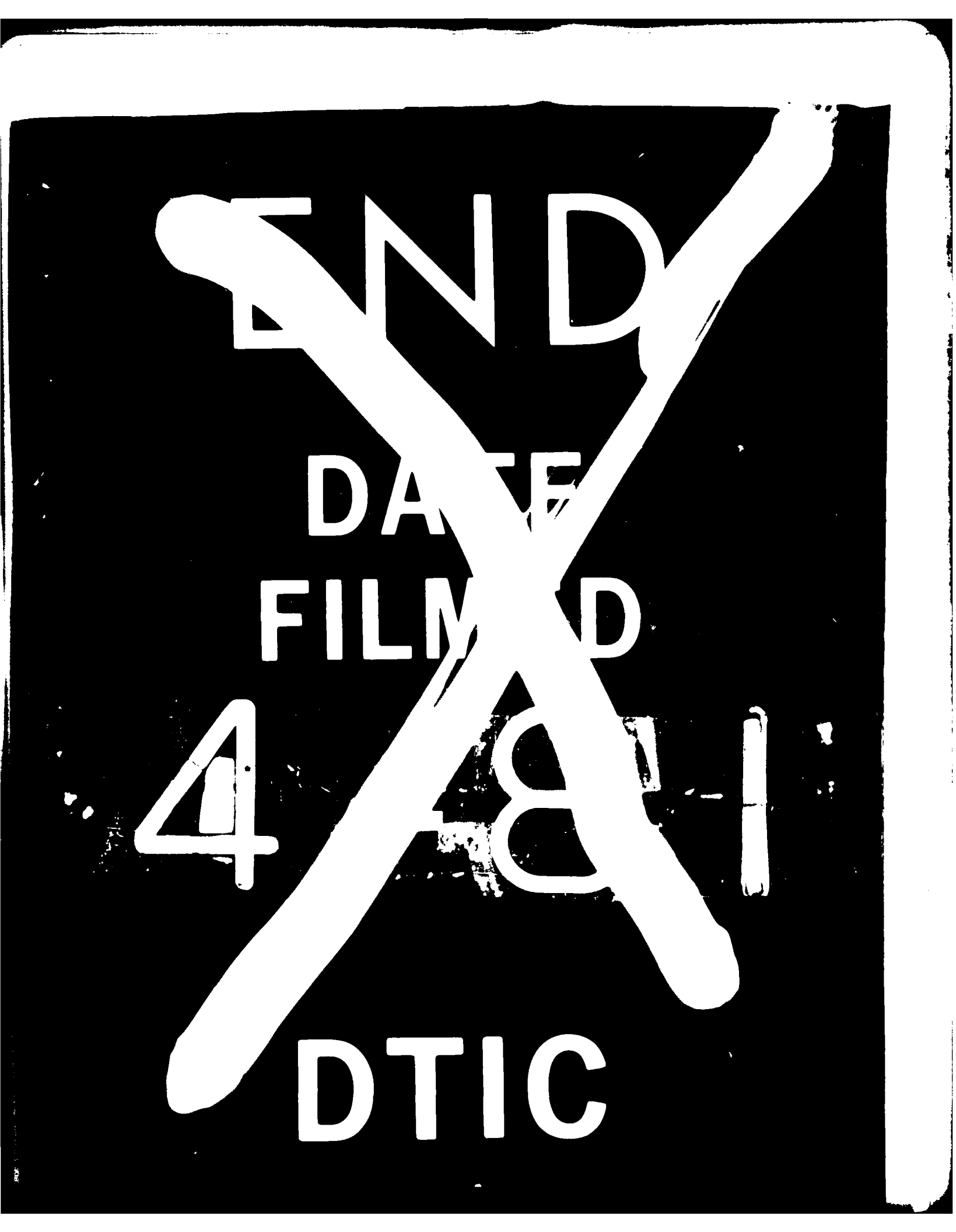
```
*
* DESIGN SUMMARY
*


WLA      ETS             TW2             STR             HEELW
      65.00000        8.333333       0.3333333        14.35441

WLAB     BW              BS                              BASER (LIST=WLBR)
      25.00000       0.                                0.

WLAH   HEELT2          HEELW          HEELT1
      18.00000        14.35441       20.49451

WLAK   NFLAG            DKEY            WKEY            BKTF
         0            0               0.              100.0000

WLAS    TSTT            TSB             TSTR            HSTPH           HSTPB
      18.00000       0                27.74709        14.26293       0.
       HSBPB
      1.616650

WLAT    RTE1            TOEHT           TS2             TW1             TS1
      43.00000        18.00000        35.90893       0.              100.0000

----   TMINB           TMINS
      18.00000        18.00000

*
* UPDATE FILE RESET
*


*
* COMMAND-DATA PHASE ENTERED
*

COMMAND
/END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT -
/5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
/MKO

$NUMB # 7507A


your update file for future restart is named EX4UPD
$stop    OK (release unneeded files)

*
```

The report file from Example 4 is similar in arrangement to that for Example 2, except for having differnet numbers, and is not shown in this user's guide. It is shown in the program validation report.

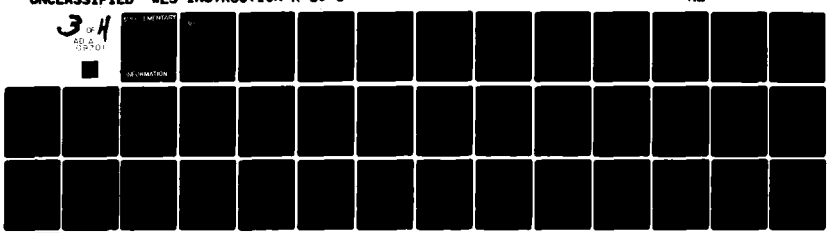
In accordance with letter from DAEN-RDC, DAEN ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.



WATERWAYS EXPERIMENT STATION
PUBLISHED UNDER THE COMMAND
STRUCTURAL ENGINEERING CASE


END
DATE
FILMED
4-81
DTIC

AD-A097 011 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS F/G 13/13
BASIC USER'S GUIDE: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF--ETC(U)
DEC 80 W A PRICE, R L HALL, H W JONES
UNCLASSIFIED WES-INSTRUCTION-K-80-6 NL



END
DATE FILMED
DTIC

CONT.

SUPPLEMENTARY

INFORMATION

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P. O. BOX 631
VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO: WESKD

15 April 1981

AD A097011

SUBJECT: Replacement Sheets for WES Instruction Report K-80-6, The Basic User's Guide for Computer Program TWDA

TO: All Recipients of Subject Report

Those sheets containing pages 10-1, 10-2, 12-3, 12-4, 13-1, 13-2, 13-7, 13-8, 13-11, 13-12, 14-1 through 14-10, 14-27 through 14-32, 14-49 through 14-54, 14-59 through 14-62, 14-65, and 14-66 should be replaced with the attached sheets containing identically numbered revised pages.

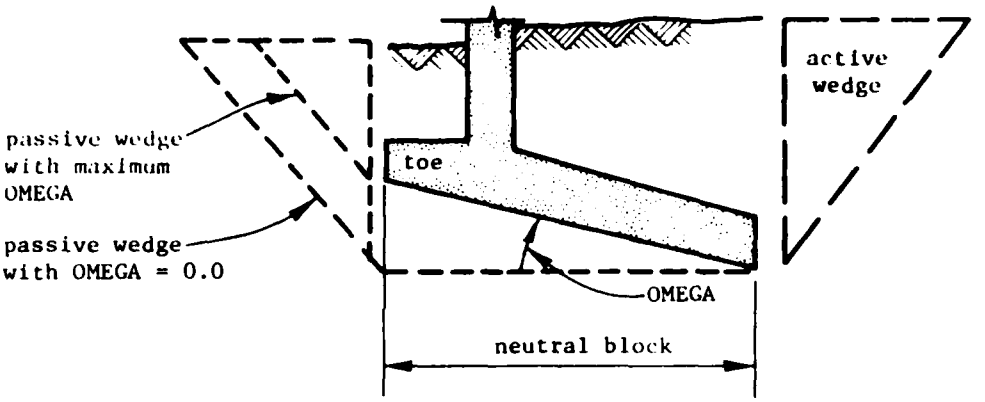
CHAPTER 10: SLIDING COMPUTATIONS

10-1 Sliding control is based on the values of KFLAG and DKEY in data lists WLAK and WLDK.

10-2 Sliding calculations use the method of wedges: active wedge beyond the heel, neutral block between the ends of the heel and the key, and a passive wedge beyond the toe.

10-3 Walls with no key and a level base use neutral block base sliding resistance calculated from the sliding friction angle and adhesion soils data values from the subgrade soil (data list SPE3 in paragraph 8-4-1).

10-4 Walls with no key and a sloping base use a variable angle OMEGA to define the bottom of the neutral block:



10-4-1 With maximum OMEGA, base sliding resistance includes the use of sliding friction and adhesion strength from the soils layers under the base, as well as the parallel component of the weight of the neutral block.

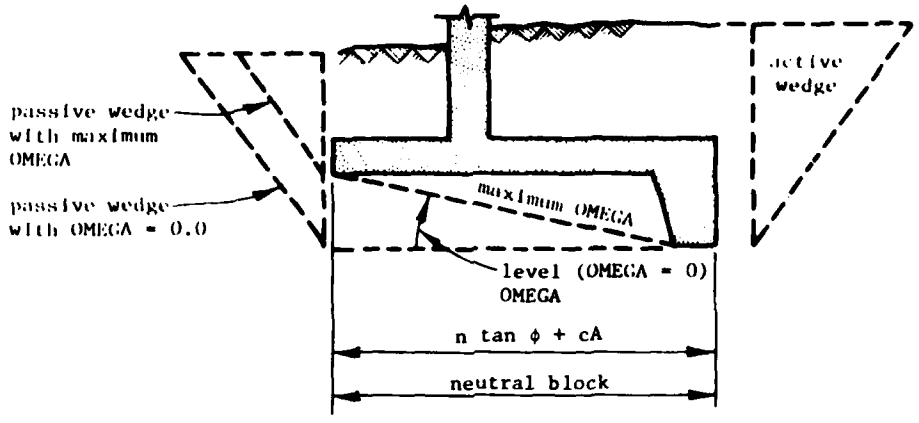
10-4-2 With OMEGA less than the maximum, base sliding resistance includes the use of soil internal friction and cohesion instead of sliding friction and adhesion.

10-5 Nomenclature for sliding (see sketches in following paragraphs):
N = normal force across bottom of neutral block
ϕ = angle of sliding friction between base slab and subgrade, data variable PHIS3 in data list SPE3 (paragraph 8-4-1)
c = adhesive strength along interface between base slab and subgrade, data variable ADHS3 in data list SPE3
A = width of bottom of neutral block in contact with the subsoil

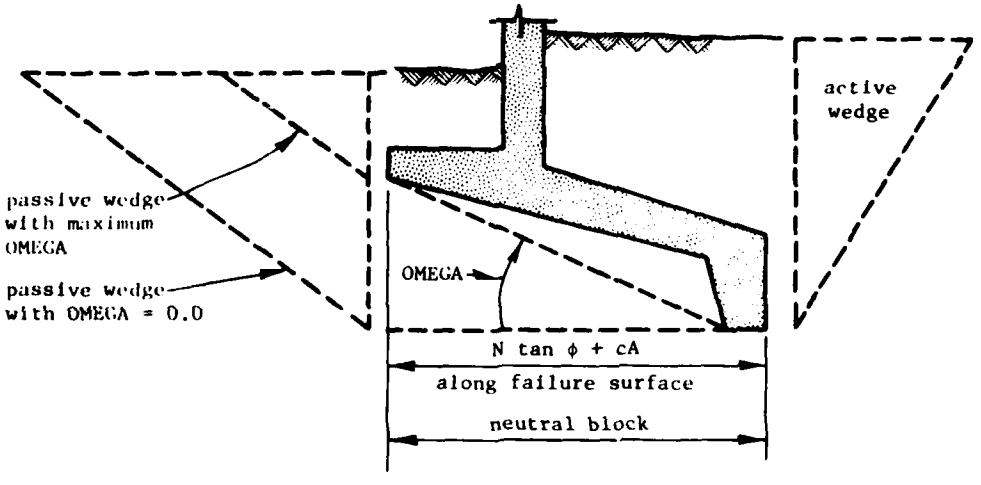
10-6 Walls with a key not less than 0.01 ft long (DKEY in data list WLAK or the result of module FD) will use a neutral block base

that depends on the value of KFLAG (data list WLAK or WLDK).

10-6-1 With KFLAG = 0 (key at end of heel), the computation will be as described in LMVD's documentation of the program specifications. The bottom of the neutral block will be like the sketch below for a level base:



And like this for a sloping base:



10-6-2 With KFLAG = 1 (key under stem), the computations will be similar to the KFLAG = 0 situation, but will be based on the descriptions given in LMVD's documentation of the program specifications and diagrammed below. Surfaces 1 and 2 are always both considered:

Data List	Data Item	Units	Definition
PPD			Passive pressure diagram ordinates
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	YTTOP	FOOT	ELEV. OF TOP OF PASSIVE PRESSURE DIAGRAMS
	WPE	PSF	MAX. PASSIVE PRESSURE FROM WIND LOAD
	EHPE	PSF	MAX. PASSIVE PRESSURE FROM EQ. HORIZ. ADDITIONAL
	HPE	PSF	MAX. PASSIVE PRESSURE FROM HORIZ.EARTH + SURCHARGE
	FHPE	PSF	MAX. PASSIVE PRESSURE FROM HORIZ.SEEPAGE
RRD			Minimum allowable resultant ratio
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	RRMIN	RATIO	MIN. ALLOWABLE OVERTURNING RESULTANT RATIO
SCFD			Direct vertical line loads on stem and base
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	PVS	LB/FT	LINE LOAD DOWN ON CENTER OF TOP OF STEM
	PVB	LB/FT	LINE LOAD DOWN ON BASE SLAB CONCRETE
	DVB	FOOT	HORIZONTAL DISTANCE, WORKING PT. TO PVB, + TO HEEL
SCFH			Direct horizontal line loads on stem
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	PH1	LB/FT	LINE LOAD HORIZ. ON STEM OR END OF TOE, + FROM HEEL
	ELPH1	FOOT	ELEV OF PH1 (ON TOE OR STEM)
	PH2	LB/FT	LINE LOAD HORIZ. ON STEM ONLY, + FROM HEEL
	ELPH2	FOOT	ELEV OF PH2 (ON STEM ONLY)
SCFV			Surcharge line loads on backfill
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	PV1	LB/FT	LINE SURCHARGE VERTICAL, NO. 1
	DV1	FOOT	HORIZ. DIST., BASIC WORK. PT. TO PV1, + OVER HEEL
	PV2	LB/FT	LINE SURCHARGE VERTICAL, NO. 2
	DV2	FOOT	HORIZ. DIST., BASIC WORK. PT. TO PV2, + OVER HEEL
	PV3	LB/FT	LINE SURCHARGE VERTICAL, NO. 3
	DV3	FOOT	HORIZ. DIST., BASIC WORK. PT. TO PV3, + OVER HEEL
	PV4	LB/FT	LINE SURCHARGE VERTICAL, NO. 4
	DV4	FOOT	HORIZ. DIST., BASIC WORK. PT. TO PV4, + OVER HEEL
	PV5	LB/FT	LINE SURCHARGE VERTICAL, NO. 5
	DV5	FOOT	HORIZ. DIST., BASIC WORK. PT. TO PV5, + OVER HEEL
SCWH			Direct horiz. pressures on stem & neutral block
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	W1	PSF	HORIZ. PRESSURE LOAD ON STEM, + FROM HEEL
	ELW1T	FOOT	ELEV OF TOP OF LOAD W1 (MUST BE ON STEM)
	ELW1B	FOOT	ELEV OF BOTTOM OF LOAD W1 (MUST BE ABOVE GRADE)
	W3	PSF	EXTERNAL HORIZ. PRESSURE AT HEEL, VALUE AT GRADE
	W4	PSF	EXTERNAL HORIZ. PRESSURE AT HEEL, VALUE AT BOTTOM
SCWV			Surcharge area loads on backfill
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	WT	PSF	VERT. DISTRIBUTED SURCHARGE OVER TOE ONLY
	WWT	FOOT	WIDTH OF STRIP LOADED BY SURCHARGE WT
	DWT	FOOT	HORIZ. DISTANCE, BASIC WORK POINT TO SURCHARGE WT
	WH	PSF	VERT. DISTRIBUTED SURCHARGE OVER HEEL ONLY
	WWH	FOOT	WIDTH OF STRIP LOADED BY SURCHARGE WH
	DWH	FOOT	HORIZ. DISTANCE, BASIC WORK. POINT TO SURCHARGE WH

(Continued)

Data List	Data Item	Units	Definition
SEEP			Water elevations and seepage options
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ELWT	FOOT	ELEV. OF WATER LEVEL OVER TOE
	ELWH	FOOT	ELEV. OF WATER LEVEL OVER HEEL (WAVE STILL WATER)
	HGSW		SOILS WEIGHT CHANGE DUE TO HYDRAULIC GRADIENT.OORX
	ISLC	1-2	1 = EACH LOAD CASE SEPARATE CREEP, 2 = ALL AS NO 1
	ISFT	1234	1, 2, 3, OR 4 FOR TYPE OF SEEPAGE FLOW, 1=CREEP
	KRACK	1-2	1 FOR CRACK (+ W3,W4) OVER HEEL, 2 FOR ACTIVE SOIL
SLID			Sliding control data - see also ONEA
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	NSLIDE	1234	1, 2, 3, OR 4 FOR SLIDING CALCULATION TYPE OPTION
	FSMIN	RATIO	MINIMUM FACTOR OF SAFETY AGAINST SLIDING
SOLP			Soils design parameters
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	IFWOC	1OR2	1 FOR INCREMENTAL WEDGE METHOD OR 2 FOR COULOMB
	NODE	EACH	NUMBER OF NODES TO USE WHEN IFWOC =1 & IFSOM = 2
	IFSOM	1OR2	1 FOR SINGLE WEDGE ON AL SURFACE, 2 FOR MULTIPLE
	NPPD	1-5	OVERTURNING PASSIVE PRESSURE SHAPE CODE, 5 = STRUT
	RKH	RATIO	HORIZ. EARTHQUAKE ACCELERATION FACTOR
	RKV	RATIO	VERT. EARTHQUAKE ACCELERATION FACTOR
	CFMA	RATIO	ACTIVE PRESSURE MOMENT ARM FACTOR FOR ARCHING CASE
SPE3			Soil properties, exist. soil layer 3 (basic)
	PHI3	DEG.	ANGLE OF INTERNAL FRICTION, SOIL LAYER 3
	COH3	PSF	COHESIVE STRENGTH OF SOIL LAYER 3
	GAMAS3	LB/CF	UNIT WEIGHT OF SOIL LAYER 3, SATURATED IF BELOW WT
	PHIS3	DEG	MAX ANGLE OF SLIDING FRICTION ON SOIL LAYER 3
	ADHS3	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER 3
	ABP3TN	PSF	ALLOW. BRNG. PRESSURE, TOP OF LAYER 3, NARROW BASE
	ABP3BN	PSF	ALLOW. BRNG. PRESSURE, BOTT OF LAYER 3, NARROW BAS
	ABP3TW	PSF	ALLOW. BRNG. PRESSURE, TOP OF LAYER 3, WIDE BASE
	ABP3BW	PSF	ALLOW. BRNG. PRESSURE, BOTT OF LAYER 3, WIDE BASE
	ELBS3	FOOT	ELEVATION CORRESPONDING TO ABP3BN AND ABP3BW
SPE4			Soil properties, existing soil layer 4
	ELTS3	FOOT	ELEV OF TOP OF SOIL LAYER 3
	PHI4	DEG.	ANGLE OF INTERNAL FRICTION,SOIL LAYER 4
	COH4	PSF.	COHESIVE STRENGTH OF SOIL LAYER 4
	GAMAS4	LB/CF	UNIT WEIGHT OF SOIL LAYER 4, SATURATED IF BELOW WT
	PHIS4	DEG.	MAX ANGLE OF SLIDING FRICTION ON SOIL LAYER 4
	ADHS4	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER 4
	ABP4TN	PSF	ALLOW. BRNG. PRESSURE TOP OF LAYER 4, NARROW BASE
	ABP4BN	PSF	ALLOW. BRNG. PRESSURE BOTT OF LAYER 4, NARROW BASE
	ABP4TW	PSF	ALLOW. BRNG. PRESSURE TOP OF LAYER 4, WIDE BASE
	ABP4BW	PSF	ALLOW. BRNG. PRESSURE BOTT. OF LAYER 4, WIDE BASE
SPE5			Soil properties, existing soil layer 5
	ELTS4	FOOT	ELEV. OF TOP OF SOIL LAYER 4
	PHI5	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 5
	COH5	PSF	COHESIVE STRENGTH OF SOIL LAYER 5
	GAMAS5	LB/CF	UNIT WEIGHT OF SOIL LAYER 5, SATURATED IF BELOW WT
	PHIS5	DEG	MAX. ANGLE OF SLIDING FRICTION ON SOIL LAYER 5
	ADHS5	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER 5
	ABP5TN	PSF	ALLOW. BRNG. PRESSURE TOP OF LAYER 5, NARROW BASE
	ABP5BN	PSF	ALLOW. BRNG. PRESSURE BOTT OF LAYER 5, NARROW BASE
	ABP5TW	PSF	ALLOW. BRNG. PRESSURE TOP OF LAYER 5, WIDE BASE
	ABP5BW	PSF	ALLOW. BRNG. PRESSURE BOTT. OF LAYER 5, WIDE BASE

(Continued)

CHAPTER 13: GRAPHICS DISPLAY OF DATA AND RESULTS

13-1 GENERAL. Module FA has the capability of displaying the input data and computed applied and reactive pressures in graphical form on a Tektronix 4014 graphics display terminal. Output examples are shown later in this Chapter. The program may be run without graphics, on any kind of terminal.

13-2 EQUIPMENT VARIATION EFFECTS. The nongraphics portion of the time-sharing terminal printout from the program does not keep track of how much has been printed on a page. It keeps on printing line after line in typical paper copy fashion. Allowing for this makes the following alternate procedure necessary, depending on which type of Tektronix terminal is available.

13-2-1 Tektronix 4014 terminal with option 40-41 installed. Use these switch settings:

a. OFF key to setting 1.

b. AUTO PRINT key to the left, for automatic printing of each page.

The screen will automatically be printed, then cleared for the next page as the printout continues with nothing lost. Use the program in the usual way, getting a stack of paper copies in the hard copy unit hopper. Answer the question at the end of module FA

```
ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD.)
  OR Ø TO OMIT THE PLOTS
?
```

with a 1. A hard copy will automatically be taken. The screen will be erased and execution will proceed as described in paragraph 13-3.

13-2-2 Tektronix 4014 terminal without the 40-41 option installed. Use a regular paper copy printing terminal such as Teletype, Texas Instruments Silent 700, DECWRITER, etc., and answer the question at the end of module FA with a zero. When module FA is complete, either stop the program run with the END command or let the terminal sit waiting for the next command while you move to a Tektronix 4014 terminal. Start the program running on the 4014 and restore (REST command in the program starting sequence) from the UPDATE file from the printing terminal program run. Note that this will not interfere with the program still running on the printing terminal provided that it is waiting for a command. Then RUN module GA, ignoring the printout until the question appears. Answer it with a 1 and proceed to paragraph 13-3. This process may be repeated each time the UPDATE file is reset in the run in the printing terminal using the REST command as described above.

13-2-3 No Tektronix 4014 terminal available. Plots are not possible.

13-3 DISPLAY OPTIONS. After the user responds to the first question with a 1, the screen is erased and the following is written:

```
NOTE --- A BELL WILL RING AT SELECTED TIMES
          TO ALLOW YOU TO MAKE A HARDCOPY IF
          YOU SO DESIRE. TO RESUME EXECUTION
          SIMPLY ENTER A CARRIAGE RETURN

ENTER 1 TO PLOT INPUT DATA
      1 TO PLOT FORCES AND MOMENTS
      * TO TERMINATE GRAPHICS
?
```

13-4 INPUT DATA. Responding to the above question with a 1 starts the input plotting portion of the code. The active load cases will be printed. The user must then enter the number of the load case he wants plotted:*

```
ACTIVE LOAD CASES
------ ---- -----
                1
                2
ENTER DESIRED ACTIVE LOAD CASE
     OR AN * TO RETURN
?
```

13-4-1 If the user responds with a load case not available, the following message is written:

```
LOAD CASE SELECTION NOT ACTIVE
```

The load case question is then repeated. If the user enters an *, the input graphics portion of the code is terminated.

13-4-2 If the user responds with a load case number that has been processed, the screen is erased and the following pictures are output:

---

* NOTE: If there is only one load case, the question will be skipped.

13-4-3 The user is then given the opportunity to plot the input for another load case:

```
ENTER 1 TO PLOT ANOTHER LOAD CASE
      Ø TO CONTINUE
?
```

Responding with a 1 returns the user to the question in paragraph 13-4. A response of 0 terminates the input plotting section of the code and returns the user to the question in paragraph 13-3.

13-5 COMPUTED MEMBER FORCES AND MOMENTS

13-5-1 If the user responds with a 2 to the question in paragraph 13-3, the output portion of TWDA is invoked. The available load case numbers are output and the user is given the opportunity to select a load case to be processed:*

```
ACTIVE LOAD CASES
------ ---- -----
                1
                2
ENTER DESIRED ACTIVE LOAD CASE
      OR AN * TO RETURN
?
```

If the user selects a load case other than the ones output, the following is output:

```
LOAD CASE SELECTION NOT ACTIVE
```

The load case question is then repeated. If the user enters an *, the output graphics portion of the code is terminated.

13-5-2 Once a correct load case has been selected, the user must then choose which member of the wall he wants output displayed for:

```
ENTER MEMBER NUMBER
     STEM --- 1
     TOE  --- 2
     KEY  --- 3
     HEEL --- 4
        * --- RETURN
?
```

---

* NOTE: If there is only one load case, the question will be skipped.

If the user responds with any number other than $1 \leq n \leq 4$, the following is output and the user is given another chance to input a member number:

```
THE 'TOE' IS NOT DEFINED FOR THIS GEOMETRY
```

The user is then given the opportunity to select another member or return:

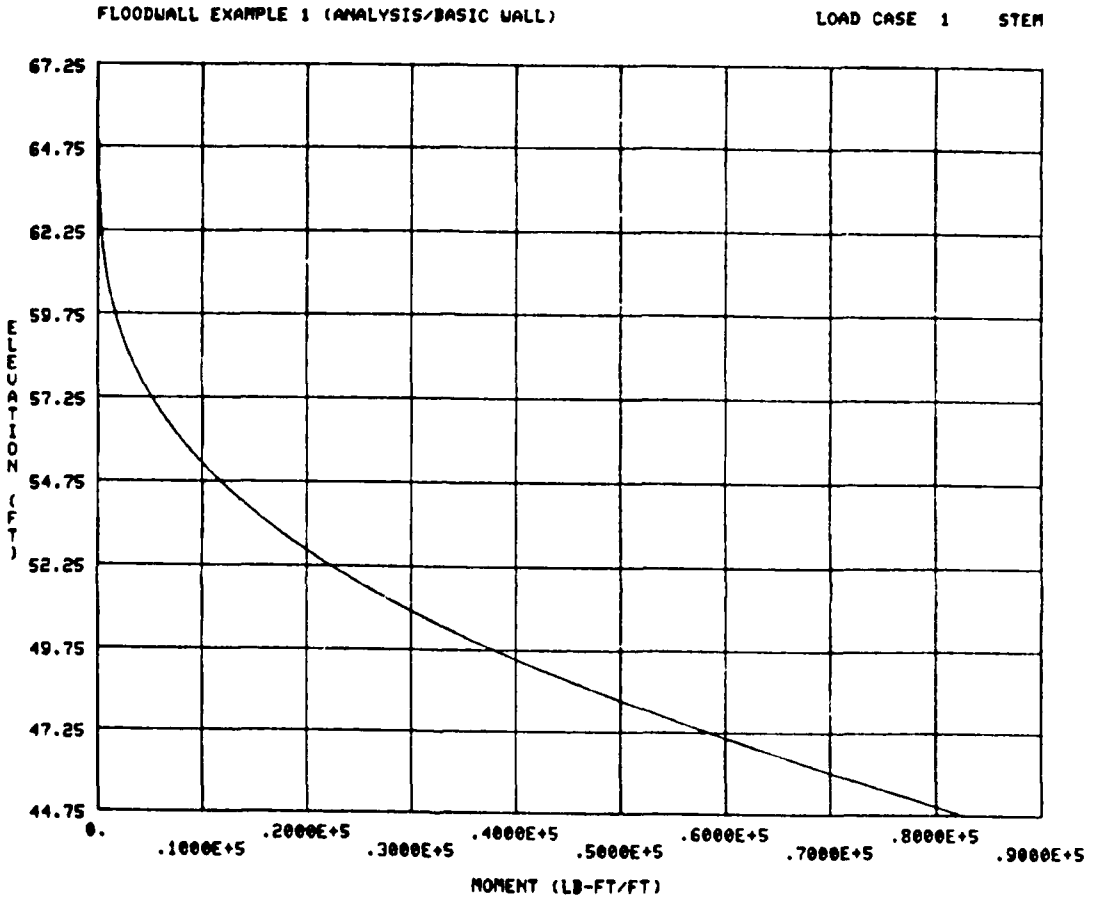
```
ENTER 1 TO PLOT ANOTHER MEMBER
      Ø TO CONTINUE
?
```

A response of 1 returns the user to the question in paragraph 13-5-2. A response of 0 returns the user to the load case selection question in paragraph 13-5-1. Any other response repeats the question. The user must enter either 0 or 1.

13-5-3 If the selection of a member (paragraph 13-5-2) is successful, the screen is erased and the plot selection is displayed to the user:

```
ENTER PLOT SELECTION
TYPE 1 --- AXIAL FORCE
     2 --- SHEAR FORCE
     3 --- MOMENT
     4 --- ALL PLOTS
     * --- RETURN
?
```

c. A response of 3 allows the user to display moment versus elevation for the member selected. An example of this is as follows:



If the user responds with 4, all of the preceding plots will be displayed sequentially with a pause between each one.

13-5-4 If the user responds with an *, the member selection portion of the output graphics routine is again invoked:

```
ENTER 1 TO PLOT ANOTHER MEMBER
      Ø TO CONTINUE
?
```

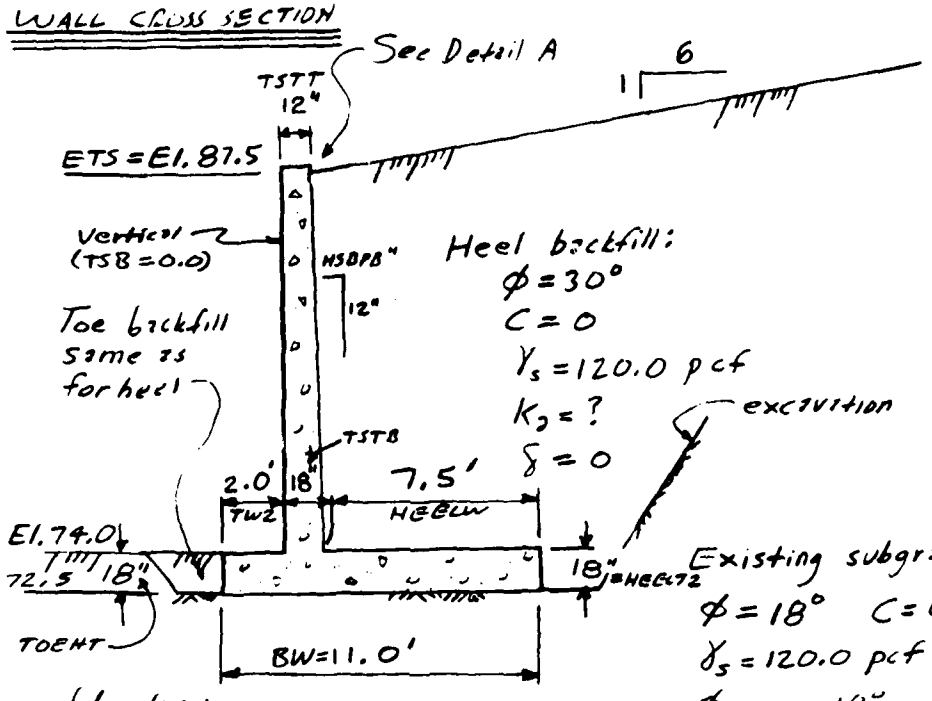
A response of 1 allows the user to select another member for plotting (paragraph 13-5-2). A response of 0 returns the user to the load case level of selection.

```
ENTER 1 TO PLOT ANOTHER LOAD CASE
      Ø TO CONTINUE
?
```

A response of 1 allows the user to select another load case to be displayed (paragraph 13-5-1). A response of 0 returns the user to input-output selection (paragraph 13-3).

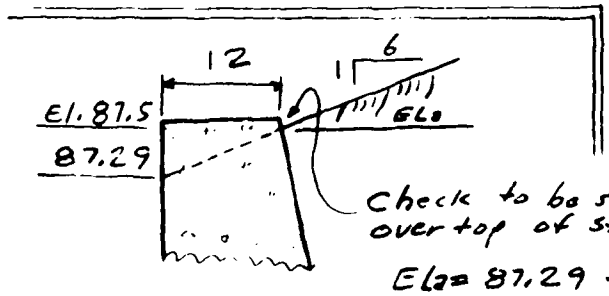
13-6 TERMINATION. Referring to the question in paragraph 13-3, a response of an * terminates the graphics portion of TWDA.

14-1 EXAMPLE 1: ANALYSIS OF A BASIC RETAINING WALL



Heel backfill:
$\phi = 30°$
$C = 0$
$\gamma_s = 120.0$ pcf
$K_a = ?$
$\delta = 0$

Existing subgrade:
$\phi = 18°$ $C = 0$
$\gamma_s = 120.0$ pcf
$\phi_{sliding} = 18°$
adhesion = 0
allowable bearing
= 3000 psf @ surface
= 4600 psf @ El. 60.0



DETAIL A
not to scale

Check to be sure that earth is not over top of stem:

$$Elg = 87.29 + \frac{12" \div 12"/1}{6}$$

$$= 87.29 + 0.17$$

$$= 87.46$$

$87.46 < 87.50$, so OK

DATA PREPARATION

Starting responses (paragraphs 7-2, 7-3a)

INIT (because this is a new problem)
1 (how many load cases)
R (for retaining wall)
N (for non-hydraulic
NAME EXAMPLE 1 -- BASIC RET WALL ANALYSIS

Selection of data lists needed (see paragraphs 3-2 & 8-1)

Use Modules FA for foundation analysis and WA for (working) stress analysis, therefore data lists SSHC, SST, SPE3, WLA, WLAB, WLAH, WLAS, WLAT, STLB, and STLS will be needed and the other lists mentioned in paragraph 8-1-3 may be used. A data list is one line of data, consisting of the list name followed by the desired values of the data items in that list. The lists may be entered in any order provided that the values in a list are in the proper order within the list, See also Chapter 5 for list preparation general rules.

Preparation of Data Lists (See paragraphs 8-3-8-11)

Soil Surfaces (data lists beginning with letters "SS"):

* Over heel (for Coulomb K), paragraph 8-3-1a

Data list name = SSHC
Use Load Case number LC=0 in case additional load cases are added later.

list name	LC	ESHW	HS3
SSHC	0	87.29	6

* Over Toe, paragraph 8-3-1 b — level grade, at elev. 74.0

list name	LC	ESTW	SST
SST	0	74.0	100.0

* Existing grade (list SSEE), paragraph 8-3-2
This list is not applicable to analysis, so is omitted.

Soils Properties (data lists beginning with the letters "SP"):

* Subgrade data list SPE3, paragraph 8-4-1

data list name	ϕ PHI3	C psf COH3	γ_s pcf GAMAS3	$\phi_{sliding}$ PHIS3	sliding adhesion psf ADHS3
SPE3	18	0	120	18	0

Allowable Bearing Pressures, psf				
Top surface BW = BW1 ABP3TN	@ELBS3 BW=BW1 ABP3BN	Top surface BW=BW2 ABP3TW	@ELBS3 BW=BW2 ABP3BW	Elev. of bottom ELBS3
3000	4600	3000	4600	60.00

* Heel backfill (because ϕ, C, or γ_s is different from the subgrade), paragraph 8-4-2 a:

list name	LC	ϕ PHI1	C psf COH1	γ_s pcf GAMAS1	K_a RKA1	δ DELTA1	K_{ae} RKAE1	min heel corner from HCMIN
SPH1	0	30	0	120	C	0	C	C

C because it is not applicable

* Toe backfill (because ϕ, C, or γ_s is different from the subgrade), paragraph 8-4-2 b:

list name	LC	ϕ PHIT	C, psf COHT	γ_s, pcf GAMAST
SPTT	0	30	0	120

Soils Foundation Design Parameters (data list SOLP), paragraph 8-5-1:
RKH and RKV are not needed because no earthquake effects are included in the problem.
CFMA is not needed because the default value of 1 is acceptable with no arching active situation.
∴ the list is not needed.

Data list RRD is not applicable to investigation, so is not needed, paragraph 8-5-2

Water - with no water, lists SEEP (para. 8-6-1) and BOIL (para 8-6-2) may be omitted.

Surcharges - With no surcharges, the lists described in paragraph 8-7 may all be omitted.

Cost data are optional for investigation, so may be omitted (paragraph 8-11).

Wall Geometry, paragraph 8-8

Use data lists with names beginning with WLA, standing for "Wall Analysis"; Omit list WLAK as being optional when there is no key. See paragraphs 8-8-3 and 8-8-4 for definitions:

	list name	ETS feet	TW2 feet	STR	HEELW feet
*	WLA	87.5	2.0	C	C

(C can be calculated from data items BW, TW2, TSTR)

	list name	BW feet	BW1 for $ABP3_B^{TN}$	BW2 for $ABP3_B^{TW}$	BS 0=level
*	WLAB	11.0	11.0	12.0	0

list name	HEELT2 inches	HEELW feet	HEELT1 inches
* WLAH	18.0	S	18.0

already established in list WLA, so "same"

list name	TSTT inches	TSB in/ft.	TSTB inches	HSTPH feet	HSTPB in/ft	HSBPB in/ft
* WLAS	12.0	0.0	18.0	0.0	0.0	

no separate top panel

already defined by other stem data

list name	BTE1 feet	TOEMT inches	TS2	TW1 feet	TS1
* WLAT	72.5	18.0	100	0.0	100

always use TW1=0 when there is no break in slope on the toe top.

Now see if data list WLDS is needed for 12" TSTT value:

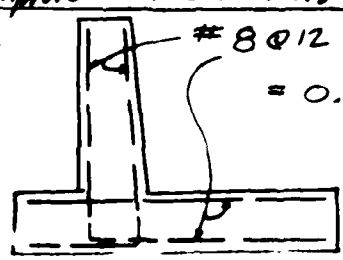
1. ETS - BTE1 = 87.5 - 72.5 = 15.0 feet high
2. Paragraph 8-8-2 b (2) says that the default for TMINS is 12 inches for height up to 15 feet, so <u>OK without</u> needing list WLDS.
3. Note: If this list had been needed it would have been entered thus:

list name	TMINS inches	TSB inches/ft.	HSTPH feet	HSTPB in/ft	HSBPB in/ft
WLDS	12.0	S	S	S	S

already established in data list WLAS

(The data are now complete for Module FA) -- add Module WA

<u>Reinforcing Steel</u>



* Bar Cover & Spacing, paragraph 8-9-2:
  Default values are all acceptable, so none of these data lists need to be used.

* Stem, paragraph 8-9-3:

list name	LOC	ASTLST(LOC) ⓓ/1	LN	ASTLSH(LOC, LN) ⓓ/1
STLS	1	0.79	1	0.79

(end of stem)

Only one use of this list is needed because there is only one layer of steel in the heel-side face and because there are no bar cutoff points.

* Key, paragraph 8-9-4: This list is not needed because there is no key.

* Toe, paragraph 8-9-5 (a):

Location code LOC = 1 at end of toe. Only one layer of steel in each face, no cutoff points:

list name	LOC	LNA	ASTLBT(LOC, LNA) ⓓ/1	LNB	ASTLBB(LOC, LNB)
STLB	1	1	0.79	1	0.79

* Heel, paragraph 8-9-5 (b):

Location code for "first" location at end of base
= BW + 1.9999, discard decimals
= 11.5 + 1.999 = 13.4999 → 13

list name	LOC	LNA	ASTLBT(LOC, LNA) ⓓ/1	LNB	ASTLBB(LOC, LNB) ⓓ/1
STLB	13	1	0.79	1	0.79

(Note paragraph 8-9-6 a.)

Concrete Analysis Parameters, paragraph 8-10:

The default values are all acceptable, so those lists (CND, CNWD, STLD) are not needed.

Automatic Alternate Load Cases, paragraph 9-1:

"Do not use this" = zero for IREM in data list CND; may be put in with list

list name	RATION Es/Ec	FPCON f'_c, psi	ESTL psi	IREM 0 or 1
CND	D	D	D	0

or interactively in Module WA -- do this way.

Data Finished -- Put into data file form:

```
1000 INIT
1010 1
1020 R
1030 N
1040 NAME  EXAMPLE 1 -- BASIC RET WALL ANALYSIS
2000 SSMC  0  87.29  6.0
2010 SST   0  74.0   100.0
3000 SPE3  18.0  0.0  120.0  18.0  0.0  3000.0  4600.0
                                  3000.0  4600.0  60.0
3010 SPH1  0  30.0  0.0  120.0  C  0.0  C  C
3020 SPT7  0  30.0  0.0  120.0
4000 WLA   87.5  2.0  C  C
4010 WLAB  11.5  11.0  12.0  0.0
4020 WLAH  18.0  S  18.0
4030 WLAS  12.0  0.0  18.0  0.0  0.0  C
4040 WLAT  72.5  18.0  100.0  0.0  100.0
5000 STLS  1  0.79  1  0.79
5010 STLB  1  1  0.79  1  0.79
5020 STLB  13  1  0.79  1  0.79
```

DATA FILE:

```
! TEST EXIDATA

1000 INIT
1010 1
1020 R
1030 N
1040 NAME  EXAMPLE 1     BASIC RETAINING WALL ANALYSIS
2000 SSHC 0  87.5  3.0
2010 SST   0   74.0   100.0
3000 SPL3 18.0.0.0 120.0 18.0.0.0 3000.0 4600.0 3000.0 4600.0 60.0
3010 SPHD   0   30.0   0.0   120.0   0.   0.0   0.   0.
3020 SPLY   0   30.0   0.0   120.0
4000 WLA   87.5   3.0   0.   0.
4010 WLAB   11.0   11.0   12.0   0.0
4020 WLAH   18.0   5.   18.0
4030 WLAS   12.0   0.0   18.0   0.0   0.0   0.
4040 WLAT   22.5   18.0   100.0   0.0   100.0
5000 SLLS   1   0.79   1   0.79
5010 SLLB   1   1   0.79   1   0.79
5020 SLLB 13   1   0.79   1   0.79
6000 UPDATE
```

TIME-SHARING TERMINAL INPUT AND OUTPUT

```
*RUN WESLIB/TWDA,R

         12/01/80     16.757


PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
      REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EX1UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?M.I.  WAITES
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?EX1DATA
PROCESSING DATA FILE

$
$ UPDATE FILE RESET
$


$
$ DATA FILE PROCESSING DONE
$
$ RETURN TO INTERACTIVE INPUT
$

COMMAND
?RUN FA
```

```
THE RESULTANT RATIO -       0 4139, FOR LOAD CASE  1


FINAL FACTOR OF SAFETY AGAINST SLIDING -      1 07, FOR LOAD CASE  1
BY SHEAR FRICTION METHOD


TOTAL CONCRETE VOLUME =          33 38 (CU FT / LF), FOR LOAD CASE  1

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE   DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD )
   OR 0 TO OMIT THE PLOTS
?0

#
# UPDATE FILE RESET
#

#
# COMMAND-DATA PHASE ENTERED
#

COMMAND
?RUN WA
#
# BEGIN MODULE WA
#

ENTER 1 TO SEE A TABLE OF X AND Y CORNER COORDINATES
   OR C TO CONTINUE WITHOUT SEEING THE TABLE
?C

TO GET DEFAULT VALUE FOR "IFEM", ANSWER NEXT QUESTION WITH A CARRIAGE RETURN

### IFEM IS NOT DEFINED, SO YOU MUST
    ENTER 0 TO USE LOAD CASES AS-IS
    OR    1 TO ALSO USE FM ALTERNATE SPECIAL LOADINGS
          (A CARRIAGE RETURN WILL INSERT THIS DEFAULT
          VALUE OF 1)
    OR    ? FOR MORE INFORMATION
    OR    C TO CONTINUE DATA CHECK WITHOUT COMPUTATIONS
    OR    * TO ABORT THE MODULE
?0

#
# BEGIN STRESS ANALYSIS
#

ENTER T TO GET THE ANALYSIS RESULTS AT YOUR TERMINAL
   OR R TO PUT THEM IN THE REPORT FILE
   OR B TO PUT THEM BOTH PLACES
?B

ENTER THE LOAD CASE NUMBER YOU WANT ANALYZED
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST "CASE"
   OR * TO STOP THE MODULE
?0

#
# BEGIN STEM STRESS ANALYSIS
#

SELECT TYPE (, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *)
?N
```

NOTE: See paragraph 7-3-3 of the User's Reference Manual for information printed in response to the ? answer. This is for the critical section locations. See paragraph 7-3-2b for an explanation of the ?, N, R, and * responses.

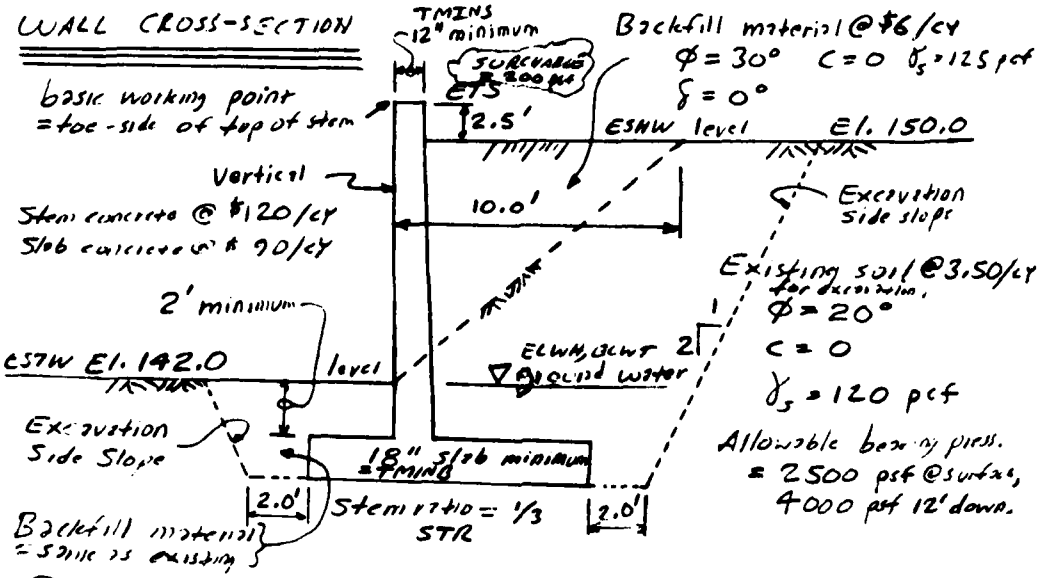
```
SHEAR AT A DISTANCE d ABOVE THE BASE--

 -- SHEAR ANALYSIS AT ELEVATION    75.17  (+ V FROM TOP PUSHED TOWARD TOE) ---
LOAD      V          N (COMP +)        M          UNIT SHEAR    ALLOWABLE   ACI318-77
CASE   LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS PROVISION
----   ----------    ----------   -----------   -----------   ----------- ----------
 1      3643.6        2272.5        14726.        20.267        60.641     B.7.4.5

MOMENT AT THE BASE--

FLEXURE ANALYSIS AT ELEVATION    74.00 (+ M = TENSION AT HEEL)
LOAD   N (COMP=+)        M          FC      FS
CASE   LB / SLICE   LB-FT/SLICE    PSI     PSI
----   ----------   -----------   -----   ------
 1        2531.        19727.      768.   18767.

STEM ANALYSIS COMPLETE TO BASE

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
?N

#
# BEGIN TOE STRESS ANALYSIS
#

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *):
?C


SHEAR AT A DISTANCE d FROM THE STEM--
---) ANALYSIS WITHIN 1-FOOT OF END OF TOE IS MEANINGLESS (---


MOMENT AT THE STEM (POINT 2)--

FLEXURE ANALYSIS AT X = -0.001 ( 1.999 FROM END OF TOE) (+ M = TENSION IN TOP)
LOAD   N (COMP=+)        M          FC      FS
CASE   LB / SLICE   LB-FT/SLICE    PSI     PSI
----   ----------   -----------   -----   ------
 1          8.         -4344.      180    4959.

TOE ANALYSIS COMPLETE TO STEM

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *):
?N

#
# BEGIN HEEL STRESS ANALYSIS
#

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
?C


SHEAR AND MOMENT AT THE STEM--

--- SHEAR ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+V = END DOWN) ---
LOAD      V          N (COMP +)        M          UNIT SHEAR    ALLOWABLE   ACI318-77
CASE   LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS PROVISION
----   ----------    ----------   -----------   -----------   ----------- ----------
 1      3940.7        1218.0        20848.        21.187        60.453     B.7.4.5

FLEXURE ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD   N (COMP=+)        M          FC      FS
CASE   LB / SLICE   LB-FT/SLICE    PSI     PSI
----   ----------   -----------   -----   ------
 1        1218.        20848.      802.   21394.
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
        16:58:45 ON 12/ 1/80


#
# BEGIN HEEL STRESS ANALYSIS
#


SHEAR AND MOMENT AT THE STEM--


----- SECTION PROPERTIES AT X =  1.501  ( 7.499 FEET FROM END OF HEEL) ----
MOM.  COMP. FACE   OVERALL   EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE      K       J
----  ----------  ---------  ----------  -----------  -------  -----  -----
 +       12.00      18.00       15.50        0.79       TOP   0.243  0.919
 -       12.00      18.00       14.50        0.79       BOTT  0.250  0.917

--- SHEAR ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+V = END DOWN) ---
LOAD       V          N (COMP +)        M          UNIT SHEAR    ALLOWABLE  ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS PROVISION
----  ----------    ----------   -----------   -----------   ----------- ---------
 1      3940.7        1218.0        20848.        21.187        60.453     8.7.4.5

FLEXURE ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD  N (COMP=+)        M          FC      FS
CASE  LB / SLICE   LB-FT/SLICE    PSI     PSI
----  ----------   -----------   -----  ------
 1        1218.        20848.     802.  21394.


SHEAR AND MOMENT AT X =   2.000


----- SECTION PROPERTIES AT X =  2.000  ( 7.000 FEET FROM END OF HEEL) ----
MOM.  COMP. FACE   OVERALL   EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE      K       J
----  ----------  ---------  ----------  -----------  -------  -----  -----
 +       12.00      18.00       15.50        0.79       TOP   0.243  0.919
 -       12.00      18.00       14.50        0.79       BOTT  0.250  0.917

--- SHEAR ANALYSIS AT X =  2.000 ( 7.000 FROM END OF HEEL) (+V = END DOWN) ---
LOAD       V          N (COMP +)        M          UNIT SHEAR    ALLOWABLE  ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS PROVISION
----  ----------    ----------   -----------   -----------   ----------- ---------
 1      3984.2        1218.0        18869.        21.421        60.453     8.7.4.5

FLEXURE ANALYSIS AT X =  2.000 ( 7.000 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD  N (COMP=+)        M          FC      FS
CASE  LB / SLICE   LB-FT/SLICE    PSI     PSI
----  ----------   -----------   -----  ------
 1        1218.        18869.     726.  19284.

#
# MODULE WA COMPLETE
#

#
# UPDATE FILE RESET
#

COMMAND ENTERED:
END
```

EXAMPLE 2: DESIGN OF A BASIC RETAINING WALL

2-1

WALL CROSS-SECTION



Problem: Vary base embedment and width to get cheapest wall to extend upper level 9'. Minimum earth cover over toe = 2.0'. Assume ground water drained down to El. 142.

DATA PREPARATION

Starting Responses, paragraphs 7-2, 7-3a

```
INIT    (new problem)
1       (1 load case)
R       (retaining wall)
H       (hydraulic structure)
NAME    EXAMPLE 2 -- BASIC RET WALL DESIGN
```

Selection of data lists, paragraphs 3-2 and 8-1 through 8-1-3

Module FD for foundation design:
1. SSHC SST SPE3 WLD WLUB WLUT required
2. NAME SSEE ... WLDK optional.

Preparation of Data Lists, paragraphs 8-3 - 8-11

Soil Surfaces (data lists beginning with letter "SS")

* Finished Grade over Heel, paragraph 8-3-1 a

list name	LC	ESHW feet	HSS3
SSHC	0	150.0	100.0 ← level

* Finished Grade over Toe, paragraph 8-3-1 b

list name	LC	ESTW	SST
SST	0	142.0	100.0

* Existing Grade, paragraph 8-3-2 (list SSEE)

EXW = 2.0 ft.

ESS = 0.5 ft horiz per foot vertical (1H = 2V)

HSSST = 100.0 (level) on toe-side (0 ok)

ELTSST = 142.0 elev. on toe-side (0 ok)

DTSST = 10' = immaterial on level surface

ELTSSW = 142.0 under basic working point

ELTSSH = 150.0 elev at DTSSH from basic working point

DTSSH = 10.0 feet from basic working point to ELTSSH

HSSSH = 100.0 = level beyond DTSSH

SSEE 2.0 0.5 100.0 142.0 10.0 142.0 150.0 10.0 100.0

Soil Properties (data lists beginning with the letters "SP"):

* Existing soil, paragraph 8-4-1:

list name	PHI3 Ø	COH3 C psf	GAMAS3 γ_s pcf	PHIS3 Ø sliding	ADHS3 adhesion psf
SPE3	20.0	0	120.0	20.0	0

ABP3TN @ surface BW = BW1	ABP3BN @ El. 130 BW = BW1	ABP3TW @ surface BW = BW2	ABP3BW @ El. 130 - BW = BW2	EL BS3
2500.0	4000.0	2500.0	4000.0	130.0

* Heel Backfill, paragraph 8-4-2 a:
This list is needed because ϕ, C, and γ are different from SPE3

list name	LC	PHI1	COH1 psf	GAMASI pcf	RKA1 constant	DELTA1 δ	RKAE1 configuration	HCMIN
SPH1	0	30.0	0.0	125.0	C	0.0	C	D

Toe Backfill, paragraph 8-4-2 b:
This list is not needed because the properties are the same as in list SPE3.

Foundation Design Parameters

With no earthquake and not-reaching active, data list SOLP is not needed.

Data list RRO is not needed because the default value of 1/3 (ETS-ELWH > 1.05') is acceptable for a retaining wall.

Water, paragraph 8-6

* Seepage, paragraph 8-6-1:

data list name	LC	ELWT over toe feet	ELWH over heel feet
SEEP	0	142.0	142.0

HGSW, ISLC, ISET, KRACK are to be the default values, so stop list here ←

* Boil control is not applicable with ELWT = ELWH so do not use list BOIL.

Surcharges, paragraph 8-7

Distributed surcharge over heel, so use list SCWV in paragraph 8-7-2: See also Figure 8-3.

list name	LC	WT psf	WWT feet	DWT feet	WH psf	WWH feet	DWH feet
SCWV	0	0.0	0.0	0.0	200.0	100.0	2.0

Wall Geometry Data, paragraph 8-8:

1. Use data lists with names beginning with WLD, standing for "Wall Design"; WLD, WLDB, WLDT are required.
2. Omit list WLDH because TMINB is acceptable for NOCUT2
3. Omit list WLDK because there is no key
4. Use list WLDS because TMINS is to be held at 12" when (ETS - BTE1) goes over 15' as BTE1 goes from BTE11 to BTE12.

list name	ETS feet	TW2 feet	STR	HGELW feet	TSTB inches	TMINB inches
WLD	152.5	C	0.333	C	C	18.0

C: to be calculated for strength

list name	BW1 feet	BW2 feet	BS1	BS2
WLDB	5.0	15.0	0.0	0.0

list name	TMINS inches	TSB in/ft	HSTPH feet	HSTPB in/ft	HSBPB in/ft
WLDS	12.0	0.0	0.0	0.0	C

list name	BTE11 feet	BTE12 feet	TOLHT inches	TW1 feet
WLDT	133.5	138.5	D	0.0

D: default to TMINB

133.5: BTE12 will probably control, with the level base and no key.

138.5: (142.0 - 2 min. cover - 1.5' TOLHT)

Selected to be below lowest probable most economical embedment

Reinforcing Steel Design, paragraphs 8-9, 8-9-1, 8-10

Data list COVR is not needed because all of the default values are acceptable. Note paragraph 8-9-5 b.

Concrete Design Parameters, paragraph 8-10

* Data list CND is needed, to set IFEM to 0 to get design for exact load case only:

list name	RATION Es/Ec	FPCON psi	ESTL psi	IFEM
CND	C	D	D	0

* Use data list CNWD to use IFDR=0 to get design for exact loadings only:

list name	RATIOF fc/fb	FYSTL psi	FSTLMX psi	IBSAME	IFDR
CNWD	D	D	D	0	0

* Data list STLD is not needed, since the default values are all acceptable.

Cost Data, paragraph 8-11:

* Backfill @ $6.00/cy = $0.22222/cf

list name	Unit costs, $/cy				
	filter zone	layer 1	layer 2	layer 6	layer 7
CSTB	0.0	0.22222	0.0	0.0	0.22222

* Concrete @ $120/cy in stem and $90/cy in slab

list name	Unit costs, $/CF		
	base slab	stem	key
CSTC	3.33333	4.44444	0.0

* Structural Excavation @ $3.50/cy

list name	Unit costs, $/CF		
	layer 3	layer 4	layer 5
CSTE	0.12963	0.0	0.0

DATA PREPARATION

Starting Responses, paragraphs 7-2 and 7-3 a

INIT (new problem)
2 (2 load cases)
F (floodwall default values selected)
H (hydraulic structure default values selected)
NAME EXAMPLE 3 -- BASIC FLOOD WALL ANALYSIS

Selection of Data Lists, paragraphs 3-2 and 8-1 thru 8-1-3

Module FA for foundation analysis

Module WA for stress analysis

Preparation of Data Lists, paragraphs 8-3 - 8-11 :

Soil Surfaces (data lists beginning with the letters "SS"):

* Finished grade over the heel, paragraph 8-3-1 a

list name	LC	ESHW feet	WSS
SSHC	0	50.0	100.0

(0 = "all load cases")

(100.0 = level ground)

* Finished grade over the toe, paragraph 8-3-1 b

list name	LC	ESTW	SST
SST	0	50.0	100.0

Finished grade of existing soil is not applicable to this analysis so data list SSET is not needed.

Soil Properties (data lists beginning with the letters "SP"):

* Subgrade data list SPE3, paragraph 8-4-1:

list name	PHI3 Φ	COH3 C, psf	GAMAS3 γ_s, pcf	PHIS3 $\phi_{sliding}$	ADHS3 sliding adhesion, psf
SPE3	15.0	400.0	125.0	15.0	400.0 →

[truncate the list here since allowable bearing pressures are not stored]

Data lists SPH1 and SPT7 are not needed because the backfill soils data are the same as for the subgrade soil and the following default values are valid (paragraph 8-4-2 a):

RKA1 is to be calculated

DELTA1 is zero

RKAE1 is zero

HCMIN is immaterial for analysis.

Foundation Design parameters

Data list SOLP paragraph 8-5-1, is not needed because all of the default values are acceptable.

Data list RRD, paragraph 8-5-2, is not needed for analysis.

Water

* Data list SEEP, paragraph 8-6-1:

list name	LC	ELWT feet	ELWH feet	
SEEP	1	50.0	65.0 →	[truncate the list here since "C" is valid for the rest of the values in the list.
SEEP	2	50.0	62.0 →	

Data list BOIL is not needed because there are no data for sheet pile cutoff criteria.

Surcharge data lists are not needed (paragraph 8-7-1)

Wall geometry data for analysis, paragraph 8-8-3a
(Data lists beginning with the letters "WLA"):

list name	ETS feet	TW2 feet	STR	HEELW feet
★ WLA	65.0	8.25	C	C

list name	BW feet	BW1 for ABP3 T_{BW}	BW2 for ABP3 T_{BW}	BS
★ WLAB	25.0	24.0	26.0	0.0

list name	HEELT2 inches	HEELW feet	HEELT1 inches
★ WLAH	18.0	C	21.0

WLAK is not needed because there is no key

list name	TSTT inches	TSB in/ft	TSTB inches	HSTPN feet	HSTPB in/A	HSBPB in/SS
★ WLAS	18.0	0.0	30.0	0.0	0.0	C

list name	BTE1 feet	TOEHT inches	TS2	TW1 feet	TS1
★ WLAT	43.0	18.0	24.0	0.0	100.0

WLBR is not needed since the wall alignment is straight

-- data complete for module FA --

Reinforcing Steel data, paragraph 8-9:

Data list COVR is not needed because the default values in paragraph 8-9-1 are acceptable.

* Stem, paragraph 8-9-3

at top (LOC=1): ASTLST(1) = *5@12 = 0.31 [11]/1

ASTLSH(1,1) = *6@12 = 0.44 [11]/1

at El. 55 (LOC=11): ASTLST(11) = *6@12 = 0.44 [11]/1

ASTLSH(11,1) = *9@12 = 1.00 [11]/1

at El. 51 (LOC=15): ASTLST(15) = same as above

ASTLSH(15,1) = *9@6 = 2.00 [11]/1

at El. 46 = top of base, steel is same as above

list name	LOC	ASTLST(LOC) [11]/1	LN	ASTLSH(LOC, LN) [11]/1
STLS	1	0.31	1	0.44
STLS	11	0.44	1	1.00
STLS	15	(5 or 0.44)	1	2.00

* Toe, paragraph 8-9-5 (2)

at outer end (LOC=1): ASTLBT(1,1) = *6@12 = 0.44 [11]/1

ASTLBB(1,1) = *9@12 = 1.00 [11]/1

5' from outer end (LOC=6): ASTLBT(6,1) = same

ASTLBB(6,1) = *9@6 = 2.00 [11]/1

@ 8' from outer end, steel is same as at 5' from outer end.

list name	LOC	LNA	ASTLBT(LOC, LNA) sq in/ft	LNB	ASTLBB(LOC, LNB) sq in/ft.
STLB	1	1	0.44	1	1.00
STLB	6	1	(5 or 0.44)	1	2.00

★ Heel, paragraph 8-9-5 (6)

LOC value at outer end:

$BW + 1.9999 = 25.0 + 1.9999 = 26.9999$

(1.9999: 4 decimals; 26.9999: LOC = 26 @ end)

@ outer end (LOC = 26): ASTLBT(1,1) = *7@12 = 0.6 (11)/1

ASTLBB(1,1) = *6@12 = 0.44 (11)/1

10' from outer end (LOC = 16): ASTLBT(1,1) = *7@6 = 1.20 (11)/1

ASTLBB(1,1) = same as at end

Steel at stem is same as at LOC = 16

list name	LOC	LNA	ASTLBT(LOC,LNA) sq in/ft	LNB	ASTLBB(LOC,LNB) sq in/ft
STLB	26	1	0.60	1	0.44
STLB	16	1	1.20	1	(S or 0.44)

Concrete analysis parameters, paragraph 8-10

Data lists CND and CNWD are not needed because all of the default values are acceptable.

Data list STLO is not applicable to analysis.

Cost data, paragraph 8-11

Not needed because there is no boundary defined between existing and backfill soil systems and because no cost data are given.

DATA READY -- BUILD DATA FILE

DATA FILE:

```
LIST EX3DATA

1000 INIT
1010 2
1020 F
1030 H
1040 NAME EXAMPLE 3 - BASIC FLOOD WALL ANALYSIS
2000 SSHC 0  50 0  100 0
2010 SST  0  50 0  100 0
3000 SPE3  15 0  400 0  125 0  15.0  400 0
3010 SEEP  1  50 0  65 0
3020 SEEP  2  50 0  62 0
4000 WLA  65 0  8 25  C  C
4010 WLAB  25 0  24 0  26 0  0 0
4020 WLAH  18 0  C  21 0
4030 WLAS  18 0  0 0  30 0  0 0  0 0  C
4040 WLAT  43 0  18 0  24 0  0 0  100 0
5000 STLS  1  0 31  1  0 44
5010 STLS  11  0 44  1  1 00
5020 STLS  15  S  1  2 00
5100 STLB  1  1  0 44  1  1 00
5110 STLB  6  1  S  1  2 00
5200 STLB  26  1  0 60  1  0 44
5210 STLB  16  1  1 20  1  S
6000 UPDATE
```

TIME-SHARING TERMINAL INPUT AND OUTPUT

```
*RUN WESLIB/TWDA,R

        12/01/80    11 855


PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
      REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EX3UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR  MAX
?M L. WAITES
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?EX3DATA
PROCESSING DATA FILE...

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPE3
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'
```

DATA PREPARATION

Convert the analysis problem in example 3 into design

Starting response, paragraph 7-3c

REST EX3UPD

NAME EXAMPLE 4 -- BASIC FLOOD WALL DESIGN

PREPARATION OF DATA LISTS, paragraph 8-1

Soil Surfaces (data lists beginning with the letters 'SS')

Finished grade, heel and toe = same as Example 3, no change

Existing grade, paragraph 8-3-2 = no change

Soil Properties (data lists beginning with letters "SP")

Same as analysis example 3 = no changes for backfill

Data list SPE3 must be used again to enter the allowable bearing pressures that were omitted in Example 3

★ Existing soil, paragraph 8-4-1

list name	PHI3 ϕ	COH3 psf	GAMAS3 γ_s, pcf	PHIS3 ϕ shring	ADHS3 adhesion psf
SPE3	S	S	S	S	S

(these items do not change, so the identifier "S" is illustrated (see paragraph 5-3-2)

ABP3TN @Surface for BW1 psf	ABP3BN @ELBS3 for BW1 psf	ABP3TW @Surface for BW2 psf	ABP3BW @ELBS3 for BW2 psf	ELBS3 feet
1500.0	1820.0	2500.0	2820.0	38.0

Foundation Design Parameters, paragraph 8-5

(with no extinguzzle and no arching active earth data list SOLP (paragraph 8-5-1) is not needed.

Data list RKO (paragraph 8-5-2) is not needed because the default values of 1/4 for load case 1 (water within 1.05 ft. of top of wall) and 1/3 for load case 2 (water more than 1.05 ft. below top of wall) are acceptable.

Water, paragraph 8-6

No change, so data list WSEF is not needed.

Surcharges, paragraph 8-7

None, so omit these lists.

Wall geometry, paragraph 8-8:

The data for analysis must be converted to data for design. The main concern in doing this is to make sure that the dimensions desired to vary during the design runs are so specified. The fastest way for the beginning user is to cancel all geometry data not used. Study of paragraph 8-8-3 shows that these data lists are needed to cancel all analysis geometry data not to be entered for design: WLAB, WLAH, WLAK (if there is a key), WLAS, and WLAT

* WLAB C C C C
* WLAH C C C
* WLAS C C C C C C
* WLAT C C C C C

Note that only one 'C' is actually needed because of the action described in paragraph 5-7.

New ord! lists beginning with "WLD" to define design geometry:

1. Data list WLDH may be omitted because TWINB is acceptable for HEELT2 (see paragraph 8-8-2 b)
2. With no key, data list WLDK may be omitted.
3. Data list WLDS may be omitted because TWINS is acceptable for TSTT with height over 15'.

list name	ETS feet	TW2 feet	STR	HEELW feet	TSTB inches	TWINB inches
★WLD	65.0	C	0.333	C	C	D

C to be calculated for strength

the list may be truncated here because the remaining values are identifiers "C" or "D"

list name	BW1 feet	BW2 feet	BS1	BS2
★WLDB	15.0	30.0	0.0	0.0

list name	BTE11 feet	BTE12 feet	TOENT inches	TW1 feet
★WLDT	39.0	43.0	D	0.0

D default = TWINB, which itself defaults to 18" with data list WLDH omitted.

Reinforcing Steel data — read the first sentence in paragraph 8-9

Concrete Design Parameters paragraph 8-10

Data list CND will be used to keep the design to the data as inputted only (IRCM = 0).

Data list CNWD will be used to keep the design based on full dead + live loads only (IRDR = 0)

All other values in data lists CND and CNWD may use their default values.

Data list STLD is not needed because its default values are acceptable.

list name	RATION n=Es/Ec	FCPCON fc, psi	ESTL Es, psi	I/OM
* CND	D	D	D	O

list name	RATIOP Fc/fc	FYSTL Fy, psi	FSTLMX fs max, psi	IOSAME	I/ODR
* CNWD	D	D	D	D	O

Cost Data, paragraph 8-11 (data lists beginning "CST...")

Excavation and backfill costs are not given, so data lists CSTB and CSTE are not applicable and should be omitted.

Data list CSTC is needed, to enter values for

Stem concrete @ $120/cy = $4.444/cf

Slab concrete @ $90/cy = $3.333/cf

list name	base slab $/cf	stem $/cf	key $/cf
* CSTC	3.3333	4.4444	0.0

ENTER DATA INTERACTIVELY

Note that the data could have been put in a data file, as described in paragraphs 6-16 and 7-32.

```
#
# BEGIN MODULE FA
#


THE RESULTANT RATIO =       0.2555, FOR LOAD CASE  1

THE RESULTANT RATIO =       0.3674, FOR LOAD CASE  2


FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.75, FOR LOAD CASE  1
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS


FINAL FACTOR OF SAFETY AGAINST SLIDING =      2.73, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS


TOTAL COST =         352.97  ($/LF), FOR LOAD CASE  1


TOTAL COST =         352.97  ($/LF), FOR LOAD CASE  2

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD.)
   OR 0 TO OMIT THE PLOTS
?0

#
# UPDATE FILE RESET
#


#
# COMMAND-DATA PHASE ENTERED
#

COMMAND
?RUN WD
#
# BEGIN DATA CHECK FOR MODULE WD
#

COMPLETE THE TRIAL WALL DESCRIPTION:

#
# BEGIN ALTERNATE METHOD (WSD) DESIGN
#

ENTER THE LOAD CASE NUMBER YOU WANT TO DESIGN FOR
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST 'CASE'
   OR A * TO ABORT THE MODULE
?0
```

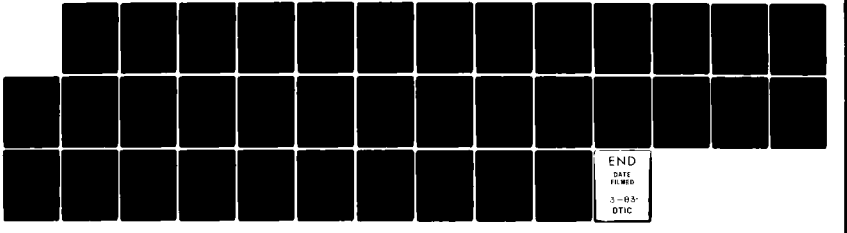
```
#
# DESIGN SUMMARY
#

WLA      ETS             TW2             STR             HEELW
      65.00000        8.333333        0.3333333       14.35441

WLAB     BW              BS                              BASER (LIST=WLBR)
      25.00000        0.                              0.

WLAH   HEELT2          HEELW          HEELT1
      18.00000        14.35441        20.49451

WLAK   KFLAG            DKEY            WKEY            BKTF
         0            0.              0.              100.0000

WLAS    TSTT            TSB             TSTB            HSTPH           HSTPB
      18.00000        0               27.74709        14.26293        0.
       HSBPB
      1.616650

WLAT    BTE1            TOEHT           TS2             TW1             TS1
      43.00000        18.00000        35.90893        0.              100.0000

----   TMINB           TMINS
      18.00000        18.00000

#
# UPDATE FILE RESET
#


#
# COMMAND-DATA PHASE ENTERED
#

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
?RO

SNUMB # 7507A


your update file for future restart is named EX4UPD
stop    OK (release unneeded files)

*
```

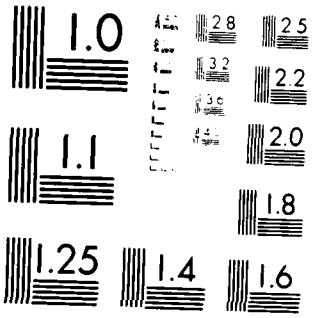
The report file from Example 4 is similar in arrangement to that for Example 2, except for having different numbers, and is not shown in this user's guide. It is shown in the program validation report.


END
DATE
FILMED
8
DTIC

AD-A097 011 BASIC USER'S GUIDE: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-..(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS W A PRICE ET AL. 4/4

UNCLASSIFIED DEC 80 WES-INSTRUCTION-K-80-6 F/G 13/13 NL





SUPPLEMENTARY

INFORMATION

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P. O. BOX 631
VICKSBURG, MISSISSIPPI 39180

REPLY TO
ATTENTION OF

WESKD

SUBJECT: Replacement Sheets for WES Instruction Report K-80-6, The Basic User's Guide for Computer Program TWDA

AD A117611

TO: All Recipients of Subject Report

1. These sheets containing pages 1-1, 2-1, 2-2, 2-4, 3-1, 8-7 through 8-10, 8-18, 8-19, 10-3, 12-4, 12-5, 14-61, 14-64, contents and new Appendix A should be replaced with the attached sheets containing identically numbered revised pages.

2. These revisions include the 21 May 1982 user notes, except that General Notes 3 and 4 are recinded. Note 3 is replaced with the revisions to ISFT in data list SEEP; the restriction noted in Note 4 is removed.

3. Questions regarding program content should be directed to W. A. Price, FTS telephone 542-3645 (commercial 601/634-3645). Questions regarding the CORPS library and accessing program CTWDA (CORPS X0053) should be directed to Dorothy May, FTS telephone 542-2724 (commercial 601/634-2724).

4. This is the second change to the Basic User Guide; the first set was dated 15 April 1981.

CONTENTS

CONTENTS

BASIC USER'S GUIDE: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (CTWDA)

CHAPTER 1: INTRODUCTION

1-1 PURPOSE OF PROGRAM CTWDA AND THIS BASIC USER'S GUIDE

1-1-1 CTWDA is a computer-aided structural design system for analysis and/or design of inverted-T cantilever walls founded on earth or rock. Multiple load cases allow the wall to act as a floodwall or a retaining wall.

1-1-2 This user's guide describes basic capabilities of CTWDA. Users are referred to the User's Reference Manual* for a complete description of capabilities and interpretation of the output.

1-2 SCOPE. Chapters 2 through 6, 10 and 11, constitute the basic instructions. Once the user has become familiar with these chapters, Chapters 7 through 9 serve as a step-by-step data preparation checklist. Chapter 12 is furnished as a data reminder list that can be used as a quick reference for coding. Chapter 13 describes the use of the graphics display capabilities. Chapter 14 presents examples of how the program can be used.

1-3 ACCESSING THE PROGRAM

1-3-1 On the computers at WES or Macon, use the command

```
*FRN WESLIB/CORPS/X0053
```

1-3-2 For use on the Boeing EKS1 system, see Appendix A.

---

* Price, W. A. et al. 1980. "User's Reference Manual: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)" Instruction Report K-80-7, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

CHAPTER 2: DESCRIPTION OF BASIC PROGRAM CAPABILITIES

2-1 GENERAL. CTWDA uses a problem-oriented command language with data grouped into named lists that may be entered in any order convenient to the user. Data and most commands may be entered interactively or via data file. Program output includes graphic display of data and results. See the documentation of the program criteria specifications* for details on structural criteria used in CTWDA.

2-1-1 Unit Slice. Stability and stress analysis and design are for a unit slice of straight wall 1 ft long.**

2-1-2 Basic Command Language. The basic command language enables the user to control:

a. Type of program start: INIT or RESTore. INIT = fresh start with all new data. REST = restart from old update file.

b. Starting a computation procedure ("module") after the required data have been entered.

c. Review and editing of data already entered using the LOOK command.

d. Resetting (updating) the update file for future use of the REST command.

e. End of a program run.

f. Requests for information about a data item or what data items are required for a given computation module.

2-1-3 Load Cases. Up to 10 load cases may be entered in each program run. Data may be designated to be for all load cases or for any 1 load case.

2-2 ACTIVE EARTH PRESSURES. The active earth pressures for basic use of the program are calculated according to Coulomb's equation for active earth pressure, as described in Engineer Manual 1110-2-2502.†

2-2-1 Basic use of CTWDA to determine floodwall stability assumes a vertical crack in the earth cover at the end of the heel, precluding use of active pressures but allowing the consideration of additional,

---

* Copies of the documentation are available from the U. S. Army Engineer Division, Lower Mississippi Valley, Vicksburg, Miss.

** A table of factors for converting inch-pound units of measurement to metric (SI) units is presented on page vii.

† Headquarters, Department of the Army. 1961. "Retaining Walls," with Change 3, 25 Jan 1965, Washington, D. C.

optional external applied water pressure in the vertical crack due to wave force base pressures.

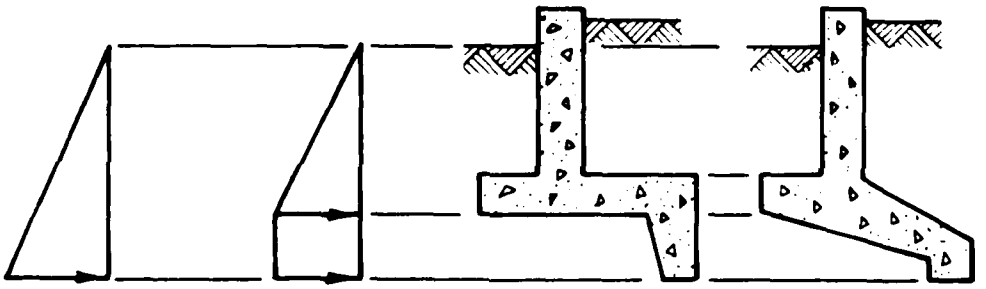
2-2-2 Basic use of CTWDA to determine retaining wall stability assumes active earth pressures at the end of the heel with no crack in the earth cover.

2-2-3 TWDA calculates active earth pressures on the stem for use in stress analysis/design.

2-3 PASSIVE EARTH PRESSURES FOR SLIDING. Passive earth pressures for sliding calculations are from Coulomb's equation, as described in EM 1110-2-2502.

2-4 HORIZONTAL EARTH RESISTANCE FOR OVERTURNING. Horizontal earth resistance for overturning calculations depends on several factors:

2-4-1 With a key, the net horizontal unbalanced force is resisted by passive pressure distributed as shown below:



passive pressure value in program for RETAINING WALLS

passive pressure value in program for FLOODWALLS

Because the wall is independently checked against sliding, there is no arbitrary limit applied to the passive pressure calculated in the overturning calculations. See the User's Reference Manual for more detailed information.

2-4-2 Without a key, the net horizontal unbalanced force is resisted by friction on the base, up to a value of

$$N \tan \phi + cA$$

where

N = resultant force normal to the base slab
ϕ = angle of sliding friction between the slab and the subgrade
c = adhesion between the slab and the subgrade, psf
A = base area in contact with the subgrade

Above this limit, the excess force is resisted by passive pressure as for a key.

2-5 SLIDING CALCULATIONS. Sliding calculations in the basic use of the program depend on the status of the key. Three conditions can be handled:

a. No key.

b. Key under the stem.

c. Key under the end of the heel.

See Chapter 10 of this user's guide and Chapter 4 of LMVD's documentation of the program specifications for more information on sliding computations.

2-5-1 Sliding for retaining walls is calculated according to Engineer Technical Letter 1110-2-164* using the shear-friction concept of the safety factor being the ratio of resisting capability to driving forces. All seepage pressures are considered as a driving force. The minimum allowable safety factor in design (module FD) is 2.0, which can be changed (see the User's Reference Manual).

2-5-2 Sliding for floodwalls is calculated according to the allowable soil strength procedures described in EM 1110-2-2501** using the multiple-plane failure surface shown in the diagram in Chapter 10. The allowable strengths are calculated according to

$$\tan \phi' = \frac{\tan \phi}{FS}$$

and

$$c' = \frac{c}{FS + 2c'}$$

where

ϕ = angle of internal friction in soil from tests
ϕ' = allowable angle of internal friction at equilibrium
c = test cohesive strength, tsf
c' = allowable cohesive strength, tsf
FS = trial factor of safety

FS is varied until a value is found to make the driving and resisting forces equal. The minimum allowable safety factor in design (Module FD)

---

* Headquarters, Department of the Army. "Gravity Dam Design--Stability," Washington, D. C.

** . 1948. "Flood Walls," with change 3, 25 Jan 1965, Washington, D. C.

is 1.5, which can be changed (see the User's Reference Manual).

2-6 UPLIFT. Uplift is calculated by the line of creep method described in EM 1110-2-2501. Different creep path descriptions are used for the three purposes described below. Other methods are available (see the User's Reference Manual).

2-6-1 Overturning calculations are exactly as shown in EM 1110-2-2501. When the vertical resultant force lies outside the kern (resultant ratio less than one third or more than two thirds), only the effective portion of the base width (the portion in bearing contact) is included in the creep path and in sliding adhesion strength. The toe-side face of the key is always included in the creep path unless ISFT = -1 in data list SEEP, in which case the toe-side face of the key is not included in the creep path when the bottom of the key is not in earth bearing contact. Basic use of the program assumes that floodwalls have a vertical crack in the earth cover at the end of the heel and that retaining walls do not. See LMVD's documentation of the program specifications for illustration.

2-6-2 Sliding calculations of creep pressures are similar to those for overturning except that the creep path follows the failure surface under the neutral block. This is along the concrete-subgrade interface only when there is no key and the maximum possible angle OMEGA is being considered (see the sliding discussion in Chapter 10).

2-6-3 Boil control creep ratio calculations in the basic use of the program use a creep path similar to that used for overturning. See paragraph 3-3-3 of the User's Reference Manual for more information on boil control capabilities. Basic use of the program reports the actual creep ratio but does not control it. For additional information, see the User's Reference Manual.

2-7 LOCATION OF VERTICAL RESULTANT FORCE. The vertical resultant fore location is controlled during overturning stability design so that it is kept within the middle third (minimum resultant ratio = 1/3) for load cases when the water level over the heel is more than 1.05 ft below the toe of stem and within the middle half (minimum resultant ratio = 1/4) for load cases where the water level over the heel is within 1.0 ft of the top of the stem.

2-8 GRAPHICS OUTPUT. Graphics output includes input data, resulting pressures, and member forces and moments. See Chapter 13 for details.

2-9 EARTHQUAKE EFFECTS. Earthquake effects are included in the calculations in CTWDA but are beyond the slope of this user's manual. See the User's Reference Manual and LMVD's documentation of the program specifications for more information.

CHAPTER 3: PROGRAM ORIENTATION

3-1 GENERAL. When the user starts program CTWDA running, it is in the command-data entry phase. After an initialization sequence of questions and answers, the program will accept either commands or data lists when the prompting message

```
COMMAND
?
```

is printed at the time-sharing terminal. When enough data lists have been entered to define the data required for a particular computation module, the command

```
RUN Module-Name
```

may be entered, to start the named module running. The data lists may be entered in any order so long as the items in each list are in the order prescribed for that list.

3-2 OPTIONS. There are four computation modules available in the basic use of the program:

Group	Module-Name	Action
Stability	FA	Foundation investigation
	FD	Foundation design
Stress	WA	Stress analysis
	WD	Stress design

In the basic use of the program, either module FA or module FD must have been completed with the message

```
#
# UPDATE FILE RESET
#
```

before modules WA or WD will run.

3-3 PROGRAM FILES. Basic use of the program includes the three different types of computer files defined below:

3-3-1 Update File. The update file must be new for each new program run. The name entered for this file must not already be in use. This file contains the execution status (data and intermediate information) of the program as of the last time the message

was printed at the user's time-sharing terminal. The file may be used only for future use with the REST command to restart after a program termination. It cannot be listed in time-sharing and can be created only by CTWDA.

3-3-2 Data File. A data file contains data lists and commands that were typed and saved into a file instead of being entered interactively. It is created by the user before starting TWDA. This file is used as input only and is not updated or changed by the program. Its use is described in detail in Chapter 6.

3-3-3 Report File. The program creates a temporary report file that the complete output is written to (only a summary output is printed to the time-sharing terminal). When the user uses the END command to stop the program, he is given the options of directing the report file to a high-speed batch terminal, saving the file as a permanent file, or destroying the file. The user must be ready with a station code if he is running on the U. S. Army Engineer Waterways Experiment Station (WES) or Office of Personnel Management, Macon, Ga., (Macon), computers. The station code is obtained from the user's ADP Center. A saved permanent report file may not be used with the REST command or as a data file. All the user can do with it is list it at a terminal. See paragraph 4-7 for instructions on how to control the amount of information written to the report file.

ELTS5W = elevation of existing ground under basic working point

ELTS5H = elevation of existing surface at a distance DTS5H on the heel side from the BWP, feet. Default = same as ELTS5W

DTS5H = horizontal distance from the BWP to ELTS5H, feet. Default = 0.0

HSS5H = existing surface slope beyond distance DTS5H, heel side, feet horizontal per foot vertical, 100.0 = level. Positive upward leaving the stem. Default = 100.0

8-4 SOIL PROPERTIES. Data Lists beginning with SP:

8-4-1 Required Data List SPE3 (Soil Properties of Existing Soil). This data list is not load case dependent. It defines the subgrade soil plus backfill earth if not separately defined and modules FA and FD have not been run.

SPE3 PHI3 COH3 GAMAS3 PHIS3 ADHS3 ABP3TN ABP3BN ABP3TW ABP3BW ELBS3

SPE3 = name of list

PHI3 = angle of internal friction, degrees. No default value.

COH3 = cohesive strength, psf. No default value.

GAMAS3 = unit weight, including weight of water if submerged, pcf. No default value

PHIS3 = maximum angle of friction along soil-concrete interface for sliding on subgrade, degrees

ADHS3 = adhesive strength along soil-concrete interface for sliding, psf

(NOTE: The rest of this list may be omitted if bearing pressure is not to be checked.)

ABP3TN = allowable bearing pressure under a wall with base width = BW1 (narrow base) as defined in paragraph 8-8-4, psf, at the top of this soil (no overburden). No default value

ABP3BN = allowable bearing pressure under a wall with base width = BW1 (narrow base), psf, at the bottom of existing soil, including weight of overburden. (At elevation ELBS3.) No default value

ABP3TW = allowable bearing pressure under a wall with base width = BW2 (wide base), psf, at the top of this soil. No default value

ABP3BW = allowable bearing pressure under a wall with base width = BW2 (wide base), psf, at the bottom of existing soil, including weight of overburden. (At elevation ELBS3.) No default value

ELBS3 = elevation of bottom of soil layer 3, feet. Basis for ABP3BN and ABP3BW. Default = 10 ft below the lowest concrete elevation

8-4-2 Optional Data Lists:

a. Data list SPH1 (soil properties of heel backfill, layer number 1). This list is not needed for a particular load case if the following conditions are true for that load case:

(1) The basic properties of internal friction angle, cohesion, and saturated earth unit weight are the same for the heel backfill as for the subgrade data list SPE3.

(2) The user is willing to use the default values shown below for data variables RKA1, DELTA1, RKAE1, and HCMIN:

Data Variable	Units	Default Value
RKA1	ratio	C (see paragraph 8-3-3)
DELTA1	degrees	0.0
RKAE1	ratio	C
HCMIN	feet	3 + 0.1[(TS - FSHW LC)] > 5.0

(3) Modules FA and FD have not yet been run.

The default values listed below are applicable when SPH1 is used for a particular load case or all load cases:

SPH1 LC PHI1 COH1 GAMAS1 RKA1 DELTA1 RKAE1 HCMIN

SPH1 = name of list

LC = load case number for this set of values

PHI1 = angle of internal friction, degrees. Default = 0.0

COH1 = cohesive strength, psf. Default = 0.0

GAMAS1 = unit weight, including weight of water if submerged, pcf. No default value

(NOTE: The list may be truncated here.)

RKA1 = horizontal active earth pressure coefficient. Will be used instead of Coulomb calculations based on PHI1, DELTA1, and stem face batter, if defined. Use of the letter C as the value will cause it to be calculated. Default = C

DELTA1 = wall friction angle for Coulomb's equation for active earth pressure coefficient, degrees. See RKA1 above. Default = 0.0.

RKAE1 = Mononobe-Okabe earthquake active earth added pressure coefficient. Will be calculated from RKH and RKV in data list SOLP if the letter C is used as a value for RKAE1

HCMIN = minimum earth backfill cover over the end of the heel, feet. Used only by module FD. Default = 3 + 0.1[ETS - ESHW(LC)] ≥ 5.0. This is the only data variable in this list that is not load case dependent.

b. Data list SPT7 (soil properties of toe backfill, layer number 7). This list is not needed for a particular load case if the data for internal friction angle (PHI3), cohesion (COH3), and saturated unit weight (GAMAS3) of data list SPE3 are also valid for the toe earth backfill, for that load case, and if modules FA and FD have not yet been run. The default values listed below are applicable when SPT7 is used for a particular load case or all load cases:

SPT7 LC PHI7 COH7 GAMAS7

SPT7 = name of list

LC = load case number for this set of values

PHI7 = angle of internal friction, degrees. Default = 0.0

COH7 = cohesive strength, psf. Default = 0.0

GAMAS7 = unit weight, including weight of water if submerged, pcf. No default value

8-5 FOUNDATION DESIGN PARAMETERS

8-5-1 Optional Data List SOLP (Soils Design Parameters). This list contains the major stability design/analysis control parameters. It is described in detail in the User's Reference Manual and is not needed for basic use of the program. The summary definitions in this user's manual are included only to show the possible versatility of the program. Chapter 2 describes the programmed action when data list SOLP is not used:

SOLP LC IFWOC NODE IFSOM NPPD RKH RKV CFMA

SOLP = name of list: soil design parameters

LC = load case number for this set of values

IFWOC = wedge method or Coulomb's method for active earth pressures

NODE = how many nodes are used to specify active earth pressures

IFSOM = wedge method control parameter

NPPD = passive pressure diagram shape control for overturning calculations

RKH = earthquake horizontal acceleration factor

RKV = earthquake vertical acceleration factor

CFMA = correction factor for active earth pressure moment arm, to include arching active

8-5-2 Optional Data List RRD (Used in Module FD Only). This list controls the limits placed on resultant vertical reaction force location in the foundation stability design calculations. It is described in detail in the User's Reference Manual and is not needed for basic use of the program. The summary definitions shown in this user's manual are included only to show the possible versatility of the program. Paragraph 2-7 describes the programmed action when data list RRD is not used:

RRD LC RRMIN

RRD = list name: resultant ratio for design

LC = load case number for this value of RRMIN

RRMIN = minimum allowable resultant ratio for stability design

8-6 WATER. Both of these lists are optional, so go on to paragraph 8-7 if there is no groundwater or pool.

8-6-1 Required Data List SEEP. The first three variables in data list SEEP define water elevations; most of the other data variables in this list are beyond the scope of this basic user's guide. Only the names of the variables are shown herein. See the User's Reference Manual for information on these variables concerning alternate methods for determining seepage pressures:

SEEP LC ELWT ELWH HGSW ISLC ISFT KRACK

SEEP = list name

LC = load case number for this set of values

ELWT = elevation of water on the toe side of the stem, feet. Default = C for "no water"

ELWH = elevation of water on the heel side of the stem, feet. Default = C for "no water"

(NOTE: The list may be truncated here.)

HGSW = use a value of C

ISLC = use a value of C

ISFT = use a value of C (for line of creep method). See para. 2-6-1.

KRACK = use a value of C. The programmed action is described in Chapter 2

8-6-2 Optional Data List BOIL. This controls calculation of the boil control creep ratio. The list is described in detail in the

8-8-4 Data Item Descriptions. (See Figure 8-4.) Wall parts are listed in the approximate order that they are used in the program:

Variable Name	Units	Default Value	Definition
			Stem Description
TSTT	in.	TMINS	Stem thickness at top. See note 11
ETS	ft	(1)	Elevation of top of stem
TSB	in./ft	0.0	Toe-side batter, inches horizontal per foot vertical
TSTB	in.	(10)	Stem thickness at base. See note 11
TMINS	in.	(3)	Minimum allowable stem thickness. See paragraph 8-8-2b(2)
HSTPH	ft	(2)	Heel-side top panel height. Should be 0.0 if no top panel. See note 13
HSTPB	in./ft	0.0	Heel-side top panel batter, inches horizontal per foot vertical. See note 13
HSBPB	in./ft	(3)	Heel-side bottom panel batter, inches horizontal per foot vertical. There must be a bottom stem thickness at base (horizontal projection). See notes 10 and 13
			Toe Description
TW1	ft	0.0	Width of part 1 of toe (at stem)
TS1	ratio	100.0	Slope of top of part 1 of toe, 1.0 vertical to TS1 horizontal, 100.0 = level. Must always be positive
TW2	ft	(4)	Width of entire toe. See note 10
TS2	ratio	100.0	Slope of top of part 2 of toe (at end), 1.0 vertical to TS2 horizontal, 100.0 = horizontal. Must always be positive
TOEHT	in.	TMINB	Toe thickness at end. Always vertical. See note 12
BTE1	ft	(1)	Elevation of bottom of toe at end
BTE11	ft	(1)	Lowest value of BTE1 in module FD
BTE12	ft	(5)	Highest value of BTE1 in module FD
STR	ratio	None	Stem ratio (Design value for TW2/BW)

(Continued)

8-8-4 Data Item Descriptions (Continued):

Variable Name	Units	Default Value	Definition
			Base Bottom Description (The values of TW2 (or STR) and BW must be such that at least one point at the toe-side face of the stem or inside the stem is an integer number of feet from the end of the toe.)
BW	ft	(6)	Base width (horizontal projection). See note 10
BW1	ft	(1)	Minimum value for BW in module FD. Also needed for allowable bearing pressure interpolation in modules FA and FD
BW2	ft	(1)	Maximum value for BW in module FD. Also needed for allowable bearing pressure interpolation in modules FA and FD. Must be larger than BW1
BS	ratio	0.0	Base bottom side slope, BS vertical to 1.0 horizontal, 0.0 = level
BS1	ratio	0.0	Minimum value for BS in module FD
BS2	ratio	0.3333	Maximum value for BS in module FD
BASER	ft	0.0	Base horizontal radius defining trapezoidal plan, measured from basic working point, positive over heel. Base is always 1.0 foot wide under the basic working point. 0.0 = rectangular (infinite radius)
TMINB	in.	(3)	Minimum allowable base slab thickness. See paragraph 8-8-2b(2)
			Key Description
KFLAG	0 or 1	1	0 if key is at end of heel; 1 if key is under stem
DKEY	ft	0.0	Key length, measured vertically along heel side
DKEY1	ft	0.0	Minimum value for DKEY in module FD
DKEY2	ft	(7)	Maximum value for DKEY in module FD
BKTF	ratio	3.0	Toe-side face batter, 1.0 horizontal to BKTF vertical
WKEY	in.	TMINB	Width (thickness) at bottom of key. See note 12

(Continued)

8-8-4 Data Item Descriptions (Concluded):

Variable Name	Units	Default Value	Definition
			Heel Description
HEELT1	in.	(8)	Thickness at stem. See note 12
HEELT2	in.	TMINB	Thickness at end, not including any key. May not be greater than HEELT1
HEELW	ft	(9)	Width (horizontal projection). See note 10

NOTES:
(1) Required data item with no default value or default calculation procedure.

(2) Will be calculated to be as large as possible. See Figures 8-4 and 8-5.

(3) Calculated by program.

(4) See paragraph 3-6-2a(1) of the User's Reference Manual.

(5) Note (1); must be below top of soil layer 7 as defined by data list SST.

(6) Three fifths of ETS-BTFI or, as determined by module FD, between BW1 and BW2.

(7) Default value for floodwall is 0.8 of ETS-BTFI if KFLAG is defined or 0.0 if KFLAG is not defined; default value for retaining walls is zero.

(8) Default values
a. TMINB
b. Top of heel must not slope down toward the stem.
c. Set at top of toe at stem if IBSAME = 1 and if it is strong enough.

(9) See paragraph 3-5-2a(3) of the User's Reference Manual.

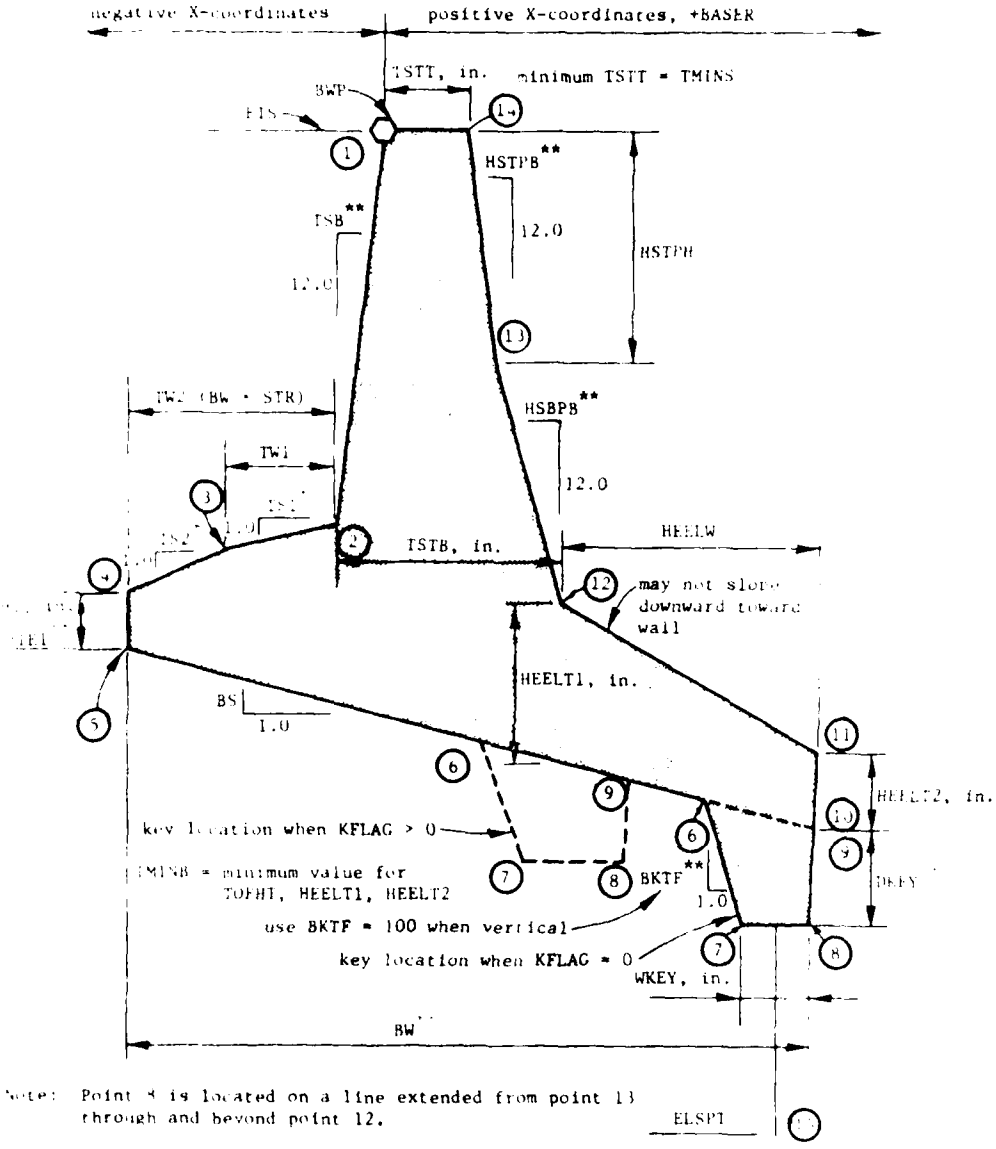
(10) Program verifies consistency of following equation, within 0.01 ft, or calculates values to complete the equation:

$$BW = TW2/STR + TW2 + TSTB/12.0 + HEELW$$

(11) May not be less than TMINS.

(12) May not be less than TMINB.

(13) When a single batter is desired on the heel-side face of the stem, use HSTPH = 0, HSTPB = anything, and use HSBPB for the single batter.



Note: Point 8 is located on a line extended from point 13 through and beyond point 12.

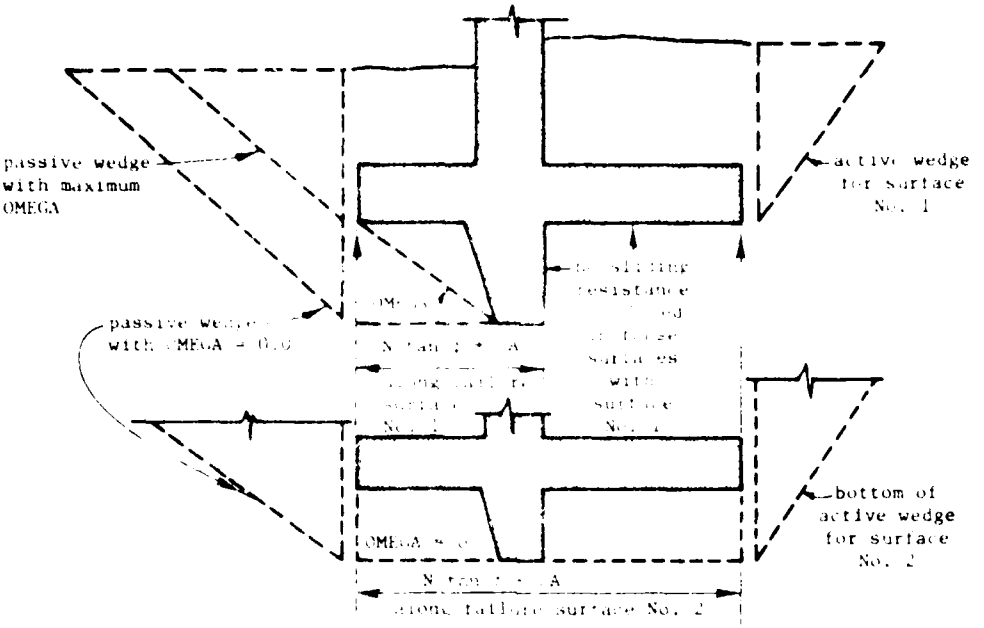
* Circled numbers are cross-sectional corner numbers.

** May never be negative.

Value = 100.0 if level; must never slope downward toward stem.

Controlled by design process in module FD.

Figure 8-4. Wall cross-sectional data variables



10-7 All circuits with OMEGA greater than zero also include the resisting force of the parallel component of the weight of the neutral block, along the inclined failure surface.

10-8 Uplift calculations for sliding include a line of creep that goes along the bottom of the neutral block and up vertically at each end of the base. Buoyant earth weights are used in the active and passive wedge calculations.

10-9 Users should consider the impact of ETL 1110-2-256, 24 June 1981, "Sliding Stability for Concrete Structures", when selecting their values of NSLIDE in optional data list SLID.

10-9-1 NSLIDE = 1 is the default action for retaining walls. Its action is described in para 2-5-1 of the Basic User's Guide, page 3-10 of the User's Reference Manual, and Exhibit H of the Program Criteria Specifications Document. It is based on ETL 1110-2-184 and uses a limit state force ratio.

10-9-2 NSLIDE = 2 is the default action for flood walls. Its action is described in para 2-5-2 of the Basic User's Guide, page 3-10 of the User's Reference Manual, and Exhibit I of the Program Criteria Specifications Document. It is based on EM 1110-2-2501 and uses allowable soil strengths in force equilibrium.

10-9-3 NSLIDE = 3 is available in the program through use of data list SLID, to conform to the sense of ETL 1110-2-256. See Exhibit J of the Program Criteria Specifications Document for a description of the action when NSLIDE = 3. Data list SLID is described below:

SLID LC NSLIDE FSMIN

where

SLID = name of data list

LC = load case number (1-10, or 0 for all cases)

NSLIDE = 3

FSMIN = minimum factor of safety on material properties, for design, using:

$$C_{allow} = \frac{C_{ultimate}}{FS}$$

$$\tan(\phi_{allow}) = \frac{\tan(\phi_{test})}{FS}$$

See para 9, page 20, of ETL 1110-2-256 for suitable values for FSMIN when NSLIDE = 3.

Data list	Data Item	Units	Definition
PPD			Passive pressure diagram ordinates
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	YTOP	FOOT	ELEV OF TOP OF PASSIVE PRESSURE DIAGRAMS
	WPE	PSF	MAX PASSIVE PRESSURE FROM WIND LOAD
	EQPE	PSF	MAX PASSIVE PRESSURE FROM EQ HORIZ ADDITIONAL
	HPE	PSF	MAX PASSIVE PRESSURE FROM HORIZ EARTH + SURCHARGE
	FRPI	PSI	MAX PASSIVE PRESSURE FROM HORIZ SEEPAGE
RRD			Minimum allowable resultant ratio
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	RRMIN	RATIO	MIN ALLOWABLE OVERTURNING RESULTANT RATIO
SCFD			Direct vertical line loads on stem and base
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	FVS	LB/FT	LINE LOAD DOWN ON CENTER OF TOP OF STEM
	FVB	LB/FT	LINE LOAD DOWN ON BASE SLAB CONCRETE
	DVB	FOOT	HORIZONTAL DISTANCE, WORKING PT TO TOE, + TO HEEL
SCFH			Direct horizontal line loads on stem
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	FH1	LB/FT	LINE LOAD HORIZ ON STEM OR END OF TOE + FROM HEEL
	ELFH1	FOOT	ELEV OF FH1 (ON TOE OR STEM)
	FH2	LB/FT	LINE LOAD HORIZ ON STEM ONLY, + FROM HEEL
	ELFH2	FOOT	ELEV OF FH2 (ON STEM ONLY)
SCFV			Surcharge line loads on backfill
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	FV1	LB/FT	LINE SURCHARGE VERTICAL, NO 1
	DV1	FOOT	HORIZ DIST, BASIC WORK PT TO FV1, + OVER HEEL
	FV2	LB/FT	LINE SURCHARGE VERTICAL, NO 2
	DV2	FOOT	HORIZ DIST, BASIC WORK PT TO FV2, + OVER HEEL
	FV3	LB/FT	LINE SURCHARGE VERTICAL, NO 3
	DV3	FOOT	HORIZ DIST, BASIC WORK PT TO FV3, + OVER HEEL
	FV4	LB/FT	LINE SURCHARGE VERTICAL, NO 4
	DV4	FOOT	HORIZ DIST, BASIC WORK PT TO FV4, + OVER HEEL
	FV5	LB/FT	LINE SURCHARGE VERTICAL, NO 5
	DV5	FOOT	HORIZ DIST, BASIC WORK PT TO FV5, + OVER HEEL
SCWH			Direct horiz pressures on stem & neutral plot
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	W1	PSF	HORIZ PRESSURE LOAD ON STEM, + FROM HEEL
	ELW1T	FOOT	ELEV OF TOP OF LOAD W1 (MUST BE ON STEM)
	ELW1B	FOOT	ELEV OF BOTTOM OF LOAD W1 (MUST BE ABOVE GRADE)
	W3	PSF	EXTERNAL HORIZ PRESSURE AT HEEL, VALUE AT GRADE
	W4	PSI	EXTERNAL HORIZ PRESSURE AT HEEL, VALUE AT BOTTOM
SCWV			Surcharge area loads on backfill
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	WT	PSF	VERT DISTRIBUTED SURCHARGE OVER TOE ONLY
	WWT	FOOT	WIDTH OF STRIP LOADED BY SURCHARGE WT
	DWT	FOOT	HORIZ DISTANCE, BASIC WORK POINT TO SURCHARGE WT
	WH	PSI	VERT DISTRIBUTED SURCHARGE OVER HEEL ONLY
	WWH	FOOT	WIDTH OF STRIP LOADED BY SURCHARGE WH
	DWH	FOOT	HORIZ DISTANCE, BASIC WORK POINT TO SURCHARGE WH

(Continued)

Data Set	Data Item	Units	Definition
WATER			Water elevation and seepage options
	LC	FACTR	LOAD CASE NUMBER (1 TO OR 0 FOR ALL LOAD CASES)
	IEWT	FLOAT	ELEV OF WATER TABLE OVER SOIL
	IEWW	FLOAT	ELEV OF WATER LEVEL OVER BELT (BACK SIDE WATER
	DESW		SOIL WEIGHT CHANGE DUE TO SATURATION (BACK SIDE
	LAY	1	1 EACH LOAD CASE SEPARATE SHEET (ALL AT FIRST
	ISOP	1,2,3	1, 2, 3, OR 4 FOR TYPE OF SEEPAGE FLOW (SEEP
	CLACE	1	ELEV OF CRACK IN WATER OVER BELT (FOR ALL LOAD
SOIL			Section control data - Combination ONLY
	LC	FACTR	LOAD CASE NUMBER (1 TO OR 0 FOR ALL LOADS)
	NSECTION	1,34	1, 2, 3, OR 4 FOR SECTIONS CALCULATION TYPE OPTION
	SMIN	RATIO	MINIMUM FACTOR OF SAFETY AGAINST SLIDING
SD			Soils design parameters
	LC	FACTR	LOAD CASE NUMBER (1 TO OR 0 FOR ALL LOADS)
	IEWOP	FOR	1 FOR INCREMENTAL WEDGE METHOD OR 2 FOR
	NOEL	FACTR	NUMBER OF NODES TO USE WHEN IEWOP = 1
	IESOM	FOR	1 FOR SINGLE WEDGE TRIAL SURFACE
	NEGE	1,5	FOR RETURNING PASSIVE PRESSURE SLOPE
	EKH	RATIO	HORIZ EARTHQUAKE ACCELERATION FACTOR
	EKV	RATIO	VERT EARTHQUAKE ACCELERATION FACTOR
	SEMA	RATIO	ACTIVE PRESSURE MOMENT ARM FACTOR FOR ARCHING
SOIL3			Soil properties, existing soil layer 3 (Back
	ANG3	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 3
	COH3	PSF	COHESIVE STRENGTH OF SOIL LAYER 3
	GAMMA3	LB/CF	UNIT WEIGHT OF SOIL LAYER 3, SATURATED IF
	SLFS3	DEG	MAX ANGLE OF SLIDING FRICTION ON SOIL LAYER
	ADHF3	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER 3
	ARF3TN	PSF	ALLOW BRNG PRESSURE, TOP OF LAYER 3
	ARF3BN	PSF	ALLOW BRNG PRESSURE, BOTT OF LAYER 3
	ARF3TW	PSF	ALLOW BRNG PRESSURE, TOP OF LAYER 3
	ARF3BW	PSF	ALLOW BRNG PRESSURE, BOTT OF LAYER 3
	EL3S	FOOT	ELEVATION CORRESPONDING TO ARF3BN AND ARF3BW
SOIL4			Soil properties, existing soil layer 4
	EL3S	FOOT	ELEV OF TOP OF SOIL LAYER 3
	ANG4	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 4
	COH4	PSF	COHESIVE STRENGTH OF SOIL LAYER 4
	GAMMA4	LB/CF	UNIT WEIGHT OF SOIL LAYER 4, SATURATED IF
	SLFS4	DEG	MAX ANGLE OF SLIDING FRICTION ON SOIL LAYER
	ADHF4	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER
	ARF4TN	PSF	ALLOW BRNG PRESSURE, TOP OF LAYER 4
	ARF4BN	PSF	ALLOW BRNG PRESSURE, BOTT OF LAYER 4
	ARF4TW	PSF	ALLOW BRNG PRESSURE, TOP OF LAYER 4
	ARF4BW	PSF	ALLOW BRNG PRESSURE, BOTT OF LAYER 4
			Soil properties, existing soil layer 5
	EL4S	FOOT	ELEV OF TOP OF SOIL LAYER 4
	ANG5	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 5
	COH5	PSF	COHESIVE STRENGTH OF SOIL LAYER 5
	GAMMA5	LB/CF	UNIT WEIGHT OF SOIL LAYER 5, SATURATED
	SLFS5	DEG	MAX ANGLE OF SLIDING FRICTION ON SOIL LAYER 5
	ADHF5	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER 5
	ARF5TN	PSF	ALLOW BRNG PRESSURE, TOP OF LAYER 5
	ARF5BN	PSF	ALLOW BRNG PRESSURE, BOTT OF LAYER 5
	ARF5TW	PSF	ALLOW BRNG PRESSURE, TOP OF LAYER 5
	ARF5BW	PSF	ALLOW BRNG PRESSURE, BOTT OF LAYER 5

(Continued)

Data List	Data Item	Units	Definition
SOIL			Soil properties, heel backfill layer 1
	LC	EACH	LOAD CASE NUMBER (1 TO 10 OR 0 FOR ALL LOAD CASES)
	PHI1	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 1
	COH1	PSF	COHESIVE STRENGTH OF SOIL LAYER 1
	GAMAS1	LB/CF	UNIT WEIGHT OF SOIL LAYER 1, SATURATED IF BELOW WT
	KA1	RATIO	ACTIVE EARTH PRESSURE COEFFICIENT FOR SOIL LAYER 1
	DELTA1	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE PRESSURE
	KAAE1	RATIO	EARTHQUAKE ACTIVE EARTH PRESSURE COEFFICIENT
	HMIN	FOOT	MINIMUM END-OF HEEL EARTH COVER CHECK VALUE
SOIL			Soil properties, heel backfill layer 2
	LC	EACH	LOAD CASE NUMBER (1 TO 10 OR 0 FOR ALL LOAD CASES)
	ELEV1	FOOT	ELEV OF TOP OF SOIL LAYER 1
	PHI2	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 2
	COH2	PSF	COHESIVE STRENGTH OF SOIL LAYER 2
	GAMAS2	LB/CF	UNIT WEIGHT OF SOIL LAYER 2, SATURATED IF BELOW WT
	KA2	RATIO	ACTIVE EARTH PRESSURE COEFFICIENT FOR SOIL LAYER 2
	DELTA2	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE PRESSURE
	KAAE2	RATIO	EARTHQUAKE ACTIVE EARTH PRESSURE COEFFICIENT
FILL			Soil properties, filter zone over heel
	LC	EACH	LOAD CASE NUMBER (1 TO 10 OR 0 FOR ALL LOAD CASES)
	FZTHK	FOOT	FILTER ZONE THICKNESS AT END OF HEEL
	PHIFZ	DEG	ANGLE OF INTERNAL FRICTION, FILTER ZONE
	COHFZ	PSF	COHESIVE STRENGTH OF FILTER ZONE
	GAMASF	LB/CF	UNIT WEIGHT OF FILTER ZONE, SATURATED IF BELOW WT
	KAAFZ	RATIO	ACTIVE PRESSURE COEFFICIENT FOR FILTER ZONE
	DELTAF	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE FILTER ZON
	KAAFFZ	RATIO	EARTHQUAKE ACTIVE PRESSURE COEFF FOR FILTER ZONE
SOIL			Soil properties, toe backfill layer 6
	LC	EACH	LOAD CASE NUMBER (1 TO 10 OR 0 FOR ALL LOAD CASES)
	PHI6	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 6
	COH6	PSF	COHESIVE STRENGTH OF SOIL LAYER 6
	GAMAS6	LB/CF	UNIT WEIGHT OF SOIL LAYER 6, SATURATED BELOW WT
SOIL			Soil properties, toe backfill layer 7
	LC	EACH	LOAD CASE NUMBER (1 TO 10 OR 0 FOR ALL LOAD CASES)
	PHI7	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 7
	COH7	PSF	COHESIVE STRENGTH OF SOIL LAYER 7
	GAMAS7	LB/CF	UNIT WEIGHT OF SOIL LAYER 7,SATURATED IF BELOW WT
SOIL			Soil surface, Existing grade & Excavation
	EXW	FOOT	EXCAVATION BOTTOM EXTRA WIDTH EACH SIDE OF BASE
	ESS	1V XH	EXCAVATION SIDE SLOPE
	HSSST	1V XH	EXIST GROUND SIDE SLOPE BEYOND ELTS5T (TOE SIDE)
	ELTS5T	FOOT	EXIST GRADE, ELTS5T FT FROM ELTS5W (TOE SIDE)
	DTS5T	FOOT	HORIZ DISTANCE FROM ELTS5W TO ELTS5T (TOE SIDE)
	ELTS5W	FOOT	EXIST GRADE DIRECTLY UNDER BASIC WORKING POINT
	ELTS5H	FOOT	EXIST GRADE, ELTS5H FT FROM ELTS5W (HEEL SIDE)
	DTS5H	FOOT	HORIZ DISTANCE FROM ELTS5W TO ELTS5H (HEEL SIDE)
	HSS5H	1V XH	EXIST GROUND SIDE SLOPE BEYOND ELTS5H (HEEL SIDE)

(Continued)

Data List	Data Item	Units	Definition
SSHC			Soil surface geometry over heel, Coulomb
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ESHW	FOOT	ELEV OF HEEL SLOPE HS1, EXTENDED UNDER B WORK PT
	HS3	1V XH	SLOPE OF THIRD HEEL SURFACE SEGMENT, 100 0 = LEVEL
SSHW			Soil surface geometry over heel, Wedge method
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ESHW	FOOT	ELEV OF HEEL SLOPE HS1, EXTENDED UNDER B WORK PT
	HS1	1V XH	SLOPE OF FIRST HEEL SURFACE SEGMENT, 100 0 = LEVEL
	DS1H	FOOT	HORIZ DISTANCE FROM BASIC WORK PT OF HS1
	HS2	1V XH	SLOPE OF 2ND HEEL SURFACE SEGMENT, 100 0 = LEVEL
	WDS2	FOOT	WIDTH OF 2ND HEEL SURFACE SEGMENT
	HS3	1V XH	SLOPE OF OUTER (3RD) HEEL SURFACE, 100 0 = LEVEL
SST			Soil surface over the toe
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ESTW	FOOT	ELEV OF TOE SLOPE TS1, EXTENDED UNDER B WORK PT
	SST	1V XH	SLOPE OF SURFACE OF SOIL LAYER / OVER TOE, 100 LEV
STLB			Reinforcing steel in the base slab
	LOC	EACH	INTEGER FT FROM TOE TOWARD HEEL, PT 1 AT TOE END
	LAYER1	EACH	LAYER NO , 1 =OUTER, 2 MAX FOR ASTLBT
	ASTLBT	SQ*/F	SQ IN / FT, REINF IN TOP FACE OF BASE SLAB
	LAYER2	EACH	LAYER NO , 1 =OUTER, 3 MAX FOR ASTLBB
	ASTLBB	SQ*/F	SQ IN / FT, REINF IN BOTTOM FACE OF BASE SLAB
STLD			Reinfrcing steel design parameters
	MAXBAR	NUMBR	ASTM REINF BAR NUMBER (3-11, 14, OR 18 ONLY) MAX
	SPAMIN	INCH	MINIMUM CLEAR SPACING BETWEEN BARS IN SAME ROW
STLK			Reinforcing steel in the key
	ASTLK	SQ*/F	SQ IN / FT, REINF IN KEY
STLS			Reinforcing steel in the stem
	LOC	EACH	INTEGER FT BELOW TOP OF STEM, PT 1 AT TOP END
	ASTLST	SQ*/F	SQ IN / FT, REINF IN TOE SIDE FACE OF STEM
	LAYER	EACH	LAYER NO , 1 = OUTER , 2 MAX FOR ASTLST
	ASTLSH	SQ*/F	SQ IN / FT, REINF IN HEEL SIDE FACE OF STEM
TRCE			Report file & debug trace control
	ITRACE	0-1	1 FOR DEBUGGING TRACE ON, 0 FOR OFF
TYPE			Flood wall / Retaining wall indicators
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ITYPE	1-2	1 FOR FLOOD WALL, 2 FOR RETAINING WALL
VLOP			Earth weight & surcharge pressures on base
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	LOC	EACH	LOCATION NUMBER (SEE USER GUIDE)
	V	PSF	EARTH WEIGHT & VERTICAL SURCHARGE
	EV	PSF	DYNAMIC (EARTH WT & VERT SURCHARGE)
WGHT			Unit weights
	GAMAC	LB/CF	UNIT WEIGHT OF REINFORCED CONCRETE (DEFAULT = 150)
	GAMAW	LB/CF	UNIT WEIGHT OF WATER (DEFAULT = 62.5)

(Continued)

New 3rd lists beginning with "WLD" to define design geometry:

1. Data list WLDH may be omitted because TMINB is acceptable for HEELT2 (see paragraph 8.8.2 b)
2. with no key, the data list WLDK must be used to cancel the KFLAG value of 0 set in Example 3. Use KFLAG = C.
3. Data list WLDS may be omitted because TMINS is acceptable for TSTT with height over 15'.

list name	ETS feet	TW2 feet	STR	HEELW feet	TSTB inches	TMINB inches
★WLD	65.0	C	0.333	C	C	D

C to be calculated for STRMATH

the list may be truncated here because the remaining values are identifiers "C" or "D"

list name	BWI feet	BW2 feet	BS1	BS2
★WLDB	15.0	30.0	0.0	0.0

list name	BTE11 feet	BTE12 feet	TOEHT inches	TW1 feet
★WLDT	39.0	43.0	D	0.0

D default = TMINB, which itself defaults to 18" with data list WLDH omitted.

Reinforcing Steel data — read the first sentence in paragraph 8.9

Concrete Design Parameters paragraph 8.10

Data list CND will be used to keep the design to the data as inputted only (IPCM = 0).

Data list CNWD will be used to keep the design based on full dead + live loads only (IPDR = 0)

All other values in data lists CND and CNWD may use their default values.

Data list STLD is not needed because its default values are acceptable.

list name	RATION n = Es/Ec	FDCON f'c, psi	ESTL Es, psi	IZOM
* CND	D	D	D	O

list name	RATIOP fc/f'c	FYSTL Fy, psi	FSTLMX fs max, psi	IOSANE	IZDR
* CNWD	D	D	D	D	O

Cost Data, paragraph 8.11 (data lists beginning "CST...")

Excavation and backfill costs are not given, so data lists CSTB and CSTE are not applicable and should be omitted.

Data list CSTC is needed to enter values for

Stem concrete @ $120/cy = $4.444/CF

Slab concrete @ $90/cy = $3.333/CF

list name	base slab $/CF	stem $/CF	key $/CF
* CSTC	3.3333	4.4444	0.0

ENTER DATA INTERACTIVELY

Note that the data could have been put in a data file, as described in paragraphs 6.1.1 b and 7.2.2.

TIME-SHARIN[illegible] [illegible] AND OUTPUT:

```
*RUN WE[illegible] TWD[illegible]

        [illegible]/01/80    12 [illegible]


PROGRAM TWDA      [illegible]
   T-WALL DESIGN ANALYSIS
       REL [illegible]   AUG [illegible]

(RESPOND WITH [illegible] FOR ANY HELP

ENTER UPDATE FILE NAME [illegible] CHAR MAX
?EXAUFD


FOR REPORT [illegible]
ENTER NAME TO BE [illegible] IN REPORT FILE [illegible] CARD  12 CHAR  MAX
?M[illegible] WA[illegible]
ENTER YOUR MA[illegible] ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY


IS THIS AN INITIAL RUN OR A RESTART OF A PREVIOUS RUN?
ENTER  INIT  OR  REST

COMMAND
?REST EX3UFD

*- ALL DATA RESET FOR FRESH START -*
*- COMMON DATA RESET FROM RESTART FILE EX3UFD    UPDATE FILE RESET -*

COMMAND
?NAME EXAMPLE 4    BASIC [illegible] WALL DESIGN

COMMAND
?SPE[illegible] [illegible] 1[illegible] 0 [illegible] 0 [illegible] 0 2820 0 38 0

COMMAND
?WLAB C

NOT ENOUGH VALUES ENTERED IN DATA LIST   WLAB
TRAILING VALUES SET TO '0'

*** WARNING *** BW1 = BW2  CAN CAUSE TROUBLE WITH ALLOWABLE BEARING PRESSURE


COMMAND
?WLAH C

NOT ENOUGH VALUES ENTERED IN DATA LIST - WLAH
TRAILING VALUES SET TO '0'
```

```
COMMAND
?WLAS C

NOT ENOUGH VALUES ENTERED IN DATA LIST - WLAS
TRAILING VALUES SET TO 'C'

COMMAND
?WLAT C

NOT ENOUGH VALUES ENTERED IN DATA LIST - WLAT
TRAILING VALUES SET TO 'C'

COMMAND
?WLD 65 0 C 0 333

NOT ENOUGH VALUES ENTERED IN DATA LIST - WLD
TRAILING VALUES SET TO 'C'

COMMAND
?WLDB 15 0 30 0 0 0 0 0

COMMAND
?WLDK C

NOT ENOUGH VALUES ENTERED IN DATA LIST - WLDK
TRAILING VALUES SET TO 'C'

COMMAND
?WLDT 39 0 43 0 D 0 0

COMMAND
?CND D D D 0

COMMAND
?CNWD D D D D 0

COMMAND
?CSTC 3 33333 4 44444 0 0

COMMAND
?UPDATE

#
# UPDATE FILE RESET
#


COMMAND
?RUN FD
#
# BEGIN MODULE FD
#


FOUNDATION STABILITY DESIGN SUMMARY--


BASE DESCRIPTION
   DATA   LOWEST     BETWEEN THE LIMITS
   ITEM    COST     ------------------
   NAME    VALUE      LOWER      UPPER          DESCRIPTION
   ----  ---------  ---------  ---------  ------------------------------
   BTE1      43 00      39 00      43 00  ELEV  OF BOTTOM OF TOE END
   BW        25 00      15 00      30 00  BASE WIDTH
   BS     0          0          0         BASE SLOPE, X VERT  TO 1 HORIZ
   DKEY      0          0          0      KEY LENGTH BELOW BASE
```

APPENDIX A

Program CTWDA Available on Boeing

29 December 1982

Program CTWDA has been placed in the CORPS program library and is now available on the Boeing Computer Service system EKS1 (BCS) in Seattle. It may be used in either of two ways, interactive or low-priority batch.

a. To use interactively, at BCS priority P15, use these interactive commands:

```
C > OLD,CORPS/UN=CECELB
C > CALL,CORPS,X0053
```

This program is then used exactly as shown in the user guide sample runs. Note, however, that this is ten times as expensive as the batch run procedure described below.

b. To use in a non-interactive batch mode, at BCS priority P02, use the procedure described below:

(1) Set up the command/data file as described in the user guides, except as follows:

(a) Place all RUN module-name and other commands in the command/data file. The END command must be in the file as the last line in the file. Exhibit A-1 is a sample run of Exhibit 1 in the Basic User Guide when used in the interactive mode. Exhibit A-2 shows the same example set to run in the batch mode. Note that none of the program modules can ask questions while the program is executing in batch. They must instead assume the default answers listed in Exhibit B.

(b) There will be no numerical answers printed to the output file shown in Exhibit C, only the skeleton output shown. All numbers will be printed in the report file shown in the user guides.

(2) Execute the batch driver for program CTWDA, with the following time-sharing commands.

```
C > GET,CTWDAB/UN=CEROS2
C > CALL,CTWDAB
```

A sample execution of CTWDAB is shown in Exhibit D.

(3) List your output file (you will have supplied a name for it when CTWDAB asked for it). To do this, use the commands

```
C > GET,filename
C > LIST,F=filename
```

If the program did not run right, you will not have a report file, and the output file will not look like the one shown in Exhibit C. You will, however, have output and report files if the program ran right.

(4) Remember that your run will leave four files in your userid:

Data file (that you created in advance)
Update file (name given to CTWDAB)
Output file (described in (3) above)
Report file (if and as named to CTWDAB)

These should be purged as soon as they are no longer needed. Use the time-sharing command

```
C > PURGE,filename
```

EXHIBIT A -- CTWDA EXAMPLE 1 DATA FILES

1. Data file EX1DATA as shown on page 14-8 of the Basic User's Guide:

```
0880 INIT
0990 1
1000 R
1010 N
1020 NAME  EXAMPLE 1  --  BASIC RETAINING WALL ANALYSIS
1030 SSHC 0  87.29  6.0
1040 SST 0  74.0  100.0
1050 SPE3 18.0 0.0 120.0 18.0 0.0 3000.0 4600.0 3000.0 4600.0 60.0
1060 SPH1 0 30.0 0.0 120.0 C 0.0 C C
1070 SPT7 0 30.0 0.0 120.0
1080 WLA 87.5 2.0 C C
1090 WLAB 11.0 11.0 12.0 0.0
1100 WLAH 18.0 S 18.0
1110 WLAS 12.0 0.0 18.0 0.0 0.0 C
1120 WLAT 72.5 18.0 100.0 0.0 100.0
1130 STLS 1 0.79 1 0.79
1140 STLB 1 1 0.79 1 0.79
1150 STLB 13 1 0.79 1 0.79
```

2. Data file EX1DATB, modified from EX1DATA for batch type run by adding lines 1200-1400:

```
0880 INIT
0990 1
1000 R
1010 N
1020 NAME  EXAMPLE 1  --  BASIC RETAINING WALL ANALYSIS
1022 REM  ***  BATCH RUN VERSION OF EX1DATA, WITH COMMANDS ***
1030 SSHC 0 87.29 6.0
1040 SST 0 74.0 100.0
1050 SPE3 18.0 0.0 120.0 18.0 0.0 3000.0 4600.0 3000.0 4600.0 60.0
1060 SPH1 0 30.0 0.0 120.0 C 0.0 C C
1070 SPT7 0 30.0 0.0 120.0
1080 WLA 87.5 2.0 C C
1090 WLAB 11.0 11.0 12.0 0.0
1100 WLAH 18.0 S 18.0
1110 WLAS 12.0 0.0 18.0 0.0 0.0 C
1120 WLAT 72.5 18.0 100.0 0.0 100.0
1130 STLS 1 0.79 1 0.79
1140 STLB 1 1 0.79 1 0.79
1150 STLB 13 1 0.79 1 0.79
1200 RUN FA
1300 CND C  C  C  0
1310 RUN WA
1400 END
```

} lines added for batch run

EXHIBIT B -- CTWDA BATCH DEFAULT ACTIONS

When the program command RUN module-name is placed in the command/data file, the following default actions are taken by the program instead of asking questions of the user.

Modules FA, FD. - Instead of asking the user if he wants graphics, the question and all graphics are omitted.

Modules WA and WD. -

1. Instead of asking the related questions, the following actions are taken:

   a. The table of coordinates is printed in the report file.

   b. Type "C" (critical section) analyses are performed for all members, in module WA.

   c. Full output is put in the report file.

   d. All load cases are analyzed.

2. Instead of asking the question

```
TO GET DEFAULT VALUE FOR "IFEM", ANSWER NEXT QUESTION WITH A CARRIAGE RETURN:

*** IFEM IS NOT DEFINED, SO YOU MUST
    ENTER 0 TO USE LOAD CASES AS-IS
    OR    1 TO ALSO USE EM ALTERNATE SPECIAL LOADINGS
            (A CARRIAGE RETURN WILL INSERT THIS DEFAULT
            VALUE OF 1)
    OR    ? FOR MORE INFORMATION
    OR    C TO CONTINUE DATA CHECK WITHOUT COMPUTATIONS
    OR    * TO ABORT THE MODULE
I>
```

when data list CND has not been used to define the variable IFEM, modules WA and WD will omit the question and use the default value of 1. To avoid this action, use data list CND. If you accept all of the other default values in CND, use this form (line 1300 in data file EX1DATB in Exhibit A):

```
CND  C  C  C  0
```

EXHIBIT C -- EXAMPLE 1 CTWDA BATCH RUN OUTPUT FILE

```
C>GET,EX1OUTB
C>LIST,F=EX1OUTB
^>@D

 PROGRAM TWDA -- 713-F3-RO 027
    T-WALL DESIGN/ANALYSIS

       REL 1.3  AUG 81
 * CORRECTED KEY SHEAR & MOMENT *

 (RESPOND WITH ? FOR ANY HELP)


 ENTER UPDATE FILE NAME (7 CHAR MAX)
 ENTER NAME OF COMMAND-DATA FILE OR
 ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
 PROCESSING DATA FILE ...


 *
 * UPDATE FILE RESET
 *

 *
 * UPDATE FILE RESET
 *

 ENTER 5 TO SEND REPORT TO REMOTE HIGH SPEED TERMINAL
 OR 0 TO SAVE IT AS A PERMANENT FILE
 OR 1 TO DETACH (DESTROY) IT --

 ENTER NAME FOR NEW PERMANENT FILE TO HOLD THE REPORT FILE (7 CHAR MAX)

 YOUR UPDATE FILE FOR FUTURE RESTART IS NAMED EX1BU
 EOI ENCOUNTERED.
C>
```

NOTES:

1. only the interactive questions are printed to this file, none of the answers that were entered into program CTWDAB.

2. None of the computed answers are printed to this file, they are all in the report file whose name was entered into program CTWDAB.

3. All program command prompting messages and the data file contents are printed to only the report file.

EXHIBIT D -- EXAMPLE 1 RUN OF BATCH DRIVER PROGRAM CTWDAB

```
C>GET,CTWDAB/UN=CEROS2
C>CALL,CTWDAB

 PROGRAM TO GENERATE A BATCH RUN OF PROGRAM CTWDA -
 DO NOT USE / OR . IN YOUR ANSWERS TO THE
 QUESTIONS TO FOLLOW.

 INPUT NAME FOR THIS JOB (7 CHAR MAX)
I>DEMO

 INPUT YOUR NAME (18 CHAR MAX)
I>W A PRICE
 INPUT YOUR TELEPHONE NUMBER (12 CHAR MAX)
I>601-634-3645
 INPUT YOUR CITY OR LOCATION (16 CHAR MAX)
I>VICKSBURG

 INPUT NAME FOR OUTPUT FILE (7 CHAR MAX)
I>DEMOOUT

 INPUT NAME FOR NEW UPDATE FILE (7 CHAR MAX)
I>DEMOUPD

 INPUT NAME OF COMMAND AND DATA FILE (7 CHAR MAX)
I>EX1DATB

 ENTER 5 TO SEND REPORT TO REMOTE HIGH SPEED TERMINAL
 OR 0 TO SAVE IT AS A PERMANENT FILE
I>5

 ENTER YOUR REMOTE TERMINAL USER NUMBER WHERE
 FILE IS TO BE DISPOSED.
I>CEROS2

 INPUT MAILING INFORMATION
I>ROUTE TO WESKD
I>FTS 542-3645
I>
 82/04/09.  14.53.38.  FILE TAPE23  IS NOW JOB LE3ALVH.
C>
```

note absence of periods

commercial, not FTS

note use of - instead of /

to tell your ADP center where to send it

NOTES:

1. The output file will contain some of the output that would be at the terminal if the run were interactive.

2. The only file that may pre-exist is the command and data file, and it must exist before running CTWDAB.

3. The job identifier printed on the last line of the run of program CTWDAB is the batch system's identifier for the execution of program CTWDA. This identifier will not apply to the report file if option "5" is selected. (Option "5" will send the completed report file to a remote high speed terminal.) If option "5" is selected in answer to the question from program CTWDAB, the system's identifier for the report file can be found by entering the time-sharing command

C > FIND

after CTWDA execution is complete.

END

DATE
FILMED

3-83

DTIC